EXHIBIT 5

REDACTED

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
ALEXANDRIA DIVISION

United States of America, *et al.*,

Plaintiffs,

v

Google LLC,

Defendant.

Case No. 1:23-cv-00108
HON. LEONIE H. M. BRINKEMA

EXPERT REPORT OF

TIMOTHY SIMCOE, PH.D.

DECEMBER 22, 2023

strategy course covers topics such as the commercialization of new technologies, industry evolution, industry structure, and strategic positioning. I also teach a Technology Strategy course to MBA and executive MBA students, a course in Data Analysis to executive MBA students, and a PhD-level class in research methods.

4. I have published over 25 peer reviewed academic articles, including in top academic economic journals such as the *American Economic Review, Management Science,* and the *RAND Journal of Economics*. I have also published numerous articles in other widely read outlets, such as policy and antitrust publications. My academic work primary falls under the economic discipline of Industrial Organization, which studies topics including competition between firms, market power, monopolies, and antitrust issues. My research covers topics including technological interoperability, innovation, and the internet.

5. My curriculum vitae, which lists all publications that I have authored or co-authored as well as a list of all matters in which I have testified in the past 10 years is attached as Appendix A.

I.B. Assignment and Compensation

6. I have been asked by Plaintiffs to estimate the percent overcharge paid by advertisers who purchase display advertisements on the open web due to exclusionary conduct by Google LLC ("Google") in several advertising technology (or "ad tech") markets. Specifically, I have been asked to estimate the percent overcharge that Google charges advertisers purchasing open web display advertisements through algorithmic real-time bidding ("RTB") on its Ad Exchange ("AdX") platform.

7. I am aware that Professor Robin Lee has also submitted a report summarizing his expert opinions on behalf of the Plaintiffs, and I rely on Professor Lee's conclusions in forming some of my opinions, as indicated in my report below. I have reviewed the Expert Report of Professor Lee, and find it to be persuasive and consistent with my own opinions, but I do not offer any independent opinions related to Professor Lee's conclusions.

8. I am being compensated for my work in this matter at my standard rate of $835 per hour. Certain employees of The Brattle Group ("Brattle") have assisted me in preparing this report. Brattle is

being compensated for its employees' time in this matter. Neither my compensation nor that of Brattle is contingent upon my findings, the testimony I may provide, or the outcome of this litigation.

9. I have also attached to this report as Appendix B a list of the materials upon which I relied in forming the opinions contained in this report. My work in this matter is ongoing, and I reserve the right to modify or supplement my conclusions as additional information is made available to me, or as I perform further analysis.

I.C. Summary of Opinions

10. The Defendant in this matter is Google LLC, a technology and software company that is wholly owned by Alphabet Inc., one of the world's largest companies by market capitalization.[1] Google offers a variety of software and internet-based products. Some Google products that are relevant to the present matter include: buy-side products for advertisers such as Google Ads (formerly AdWords), Google Search Network, Google Display Network, Google Marketing Platform, Display & Video 360 ("DV360"), Campaign Manager, Studio, Search Ads 360 and Google Analytics 360 Suite,[2] and sell-side products for publishers such as AdSense, AdMob, and Google Ad Manager ("GAM").[3]

11. I have estimated the proportion of the fees on Google's AdX platform that is attributable to the exclusionary conduct at-issue in this case. In particular, I have computed the percent overcharge

---

[1] As of May 5, 2023, Alphabet Inc. is the fourth largest company in the world by market capitalization. Einar H. Dyvik, "The 100 Largest Companies in the World by Market Capitalization in 2023," Statista, August 20, 2023, https://www.statista.com/statistics/263264/top-companies-in-the-world-by-market-capitalization/ ("With a market capitalization of 2.75 trillion U.S. dollars as of May 2023, Apple was the world's largest company that year. Rounding our the top five were some of the world's most recognizable brands: Microsoft, Saudi Arabian Oil Company (Saudi Aramco), Google's parent company Alphabet, and Amazon.").

[2] GOOG-DOJ-AT-01917966, at -007 (10/10/2020) ("Google Advertiser-side Ad Tech Products…Google Search Network…Google Display Network…Display & Video 360…Campaign Manager…Studio…Search Ads 360…Google Analytics 360 Suite").

[3] GOOG-DOJ-AT-01917966, at -008 (10/10/2020) ("Google Publisher-side Ad Tech Products…AdSense…AdMob…Google Ad Manager").

As described below, GAM was previously marketed as two separate products: a publisher ad server, called DoubleClick for Publishers ("DFP"), which provided publisher-facing tools for inventory management, and an "ad exchange" called DoubleClick Ad Exchange ("AdX") that managed the auctions used to allocate individual advertising impressions. Google announced that these products would be merged in July 2018.

for web display ad impressions purchased via RTB on the AdX platform. I have reached this conclusion by analyzing documents and data that were produced in this case, and publicly available information. I find that, but-for Google's exclusionary conduct, the fees charged by Google for use of the AdX platform between January 2019 and January 2023 would be at least 17.9 percent lower than the fees that Google actually charged. Stated differently, absent Google's conduct, the average 19.8 percent fee that Google charges for use of its AdX platform would be at least 16.2 percent or below. Moreover, this estimated overcharge is likely to be conservative because, when considering a number of factors that would lead to a larger difference between the fees that Google charges in the but-for world and the "as-is" world, I rely upon assumptions that produce larger estimated fees in the but-for world, and therefore a smaller overcharge.

12. The fees that Google charges for its AdX platform are similar to an *ad valorem* tax, such as a sales tax, that is expressed as a percentage of the price paid in a transaction between an advertiser and a publisher. Economics teaches that *ad valorem* taxes are paid by both buyers and sellers. I use a standard economic model of "tax incidence" to apportion Google's total overcharge between advertisers, who pay higher prices to purchase advertisements through AdX due to Google's at-issue conduct, and publishers who receive lower payments for advertisements sold through AdX due to Google's at-issue conduct. I estimate that 19.3 percent of the direct cost of AdX's overcharge is borne by advertisers on AdX in the form of increased prices for their ad purchases on the platform. Moreover, if I account for the impact of Google's overcharge on the price that advertisers pay for their ad purchases on the platform, the total harm increases and advertisers would incur 24.6 percent of that larger amount.

13. In Section II of this report, I first describe the ad tech space, including the products and technologies used to buy and sell open web display advertising impressions on the internet. I also describe the products that Google, the Defendant in this matter, offers within the ad tech space.

14. In Section III, I describe open web display advertising and the relevant antitrust markets, and I provide summary statistics that illustrate some basic facts about pricing and output in those markets. Next, I describe Google's exclusionary conduct and how it relates to the but-for world in my analysis. As Professor Lee has demonstrated, the fees that advertisers and publishers pay Google to use its ad tech tools are larger than they otherwise would be due to Google's

FIGURE 2: COMPONENTS OF THE AD TECH "STACK"

	Publisher Ad Server	Ad Exhange / Sell-Side Platform	Buyer Tools	
			DSP	Ad Network
Functionality	Ad serving logic Publisher controls Monitoring and reporting	RTB auction management Inventory to bid matching	Bidding strategy User targeting Campaign mgmt	Simplified bid tools CPM-to-CPC pricing Reporting
Google Product	Ad Manager (GAM/DFP)	AdX	DV360	Google Ads
Typical Pricing	Volume tier fee per direct impression served. Waived if exchange fee is charged. Low tier at GAM is $0.085 CPM.	"Take rate" or ad-valorem transaction taxon advertiser payments. Google averages 20% take rate on AdX.	Revenue share (similar to take rate) with volume discounts.	"Margin" based on difference between CPC fees and CPM costs.
Other Providers	Equativ Xandr	Equativ, Magnite (Rubicon), OpenX, Index Exchange, Xandr, Yahoo	Adobe, Amazon, TradeDesk, Verizon, Xandr	Criteo

Source: Lee Report, Section II.B.1, Section II.D, Section IV.C, Section IV.D, and Section II.B.2.a.

II.B.1. Publisher Ad Servers

30. Publisher ad servers allow publishers to connect with the ad tech ecosystem and automate the management of their ad inventory. These pieces of software allow publishers to set parameters that determine which advertisements will be allocated to each impression in their inventory—including impressions allocated through both direct and indirect sales channels.[24] To conduct an RTB auction, publisher ad servers must first integrate or connect with ad exchanges. If an ad server and an ad exchange are integrated, then the server can send "bid requests" for a particular impression to the exchange, and in turn, receive offers to purchase that impression from advertisers who also connect to the exchange.

31. As the layer in the stack that makes the final decision regarding what advertisement is matched to each impression opportunity, a publisher ad server is responsible for routing specific advertisements to individual web browsers.[25] Publisher ad servers may also have other features

---

[24] *See* Lee Report, Section II.B.1.; *see also*, "The Main Technology Platforms and Intermediaries in the Digital Advertising Ecosystem," The AdTech Book by Clearcode, accessed December 19, 2023, https://adtechbook.clearcode.cc/adtech-platforms-and-intermediaries ("All of the popular advertising agencies have their own agency trading desk which runs the programmatic media-buying activities for the agency's clients." and "First-Party Ad Server…This technological platform allows publishers to manage the ad slots on their website and display ads that have been sold directly to advertisers (i.e. direct campaigns).").

[25] *See* Lee Report, Section II.B.1.

55. Advertisers often work with ad agencies to select buyer tools based on the objectives of a specific advertising campaign.[71] The advertising agency helps to determine the goals and scope of the campaign, develop a plan to achieve those goals, and works with the advertiser to set a budget for the campaign.[72] During a campaign, advertisers can track their spending and click conversions to evaluate the effectiveness of an ad campaign on a continuous basis.[73] Advertisers then use this information to update the configuration of buyer tools. By changing their user targeting, bidding strategies (i.e., which auctions to enter and how much to bid), and pacing (i.e., the rate at which impressions are purchased and specific ads are displayed to a user),[74] advertisers seek to maximize the overall return on their advertising investment. This dynamic process means that an advertiser's spending may vary day-to-day depending on the volume of relevant ad inventory.[75]

56. A final aspect of tool configuration occurs among ad tech tool suppliers, who choose the set of supply- and demand-side partners with whom they will work inside the stack. For instance, the supplier of a publisher ad server decides whether to invest in integrating its software with various ad exchanges, DSPs, and advertiser ad networks before it can send (or respond to) bid requests

---

71 Examples of leading ad agencies include WPP, Omnicom, Publicis, and IPG. *See* "'Big 4' Advertising Agencies, Part 1: Introducing the Companies and Industry," Seeking Alpha, April 21, 2016, https://seekingalpha.com/article/3967004-big-4-advertising-agencies-part-1-introducing-companies-and-industry.

72 Deposition of Susan Schiekofer (GroupM), September 26, 2023, 17:16–19:18 ("[Q.] Does GroupM have different teams that focus on different types of advertising?...THE WITNESS:…What clients hire us for are to look at their audiences and plan audiences accordingly…So it's basically taking, like, syndicated research as well as, you know, any client specific results data, and coming up with a broad swatch of plans to allocate by channel. So they'll allocate, you know, 20 percent of the budget should be TV, you know, 10 percent should be search…And then the individual buying teams will then buy accordingly and pick partners accordingly.").

73 *See*, *e.g.*, "About Conversion Tracking," Google Ads Help, accessed December 19, 2023, https://support.google.com/google-ads/answer/1722022 ("**Conversion tracking** is a free tool that shows you what happens *after* a customer interacts with your ads - whether they purchased a product, signed up for your newsletter, called your business, or downloaded your app… See which keywords, ads, ad groups, and campaigns are best at driving valuable customer activity.") (emphasis in original).

74 *See* Lee Report, Section IV.C.

75 "About Average Daily Budgets," Google Ads Help, accessed December 19, 2023, https://support.google.com/google-ads/answer/6385083 ("Google will optimize your campaign spend for days of the month when you're more likely to get clicks and conversions…This means that on some days we might not reach your average daily budget, and on others we might exceed it.").

III. Relevant Markets and Alleged Conduct

59. This section describes the markets where FAAs purchase ad tech services that facilitate buying open web display advertising impressions and explains how Google's conduct led to reduced competition and higher prices in those product markets. These markets include the worldwide market for publisher ad servers, ad exchanges, and advertiser ad networks, as described in Professor Lee's Report.

60. Section III.A describes the relevant antitrust markets. Section III.B reports statistics and background information about open display web impressions sold through the tools in these markets. Section III.C describes Google's anticompetitive conduct, and Section III.D characterizes a "but for" world without Google's conduct. Finally, I discuss purchases made by FAAs in the relevant markets in Section III.E.

III.A. Relevant Markets

61. In antitrust economics, identifying relevant antitrust markets allows economists and courts to determine the groups of products that competitively constrain one another.

62. Professor Lee's Report describes two different geographic boundaries for the relevant markets in this matter: the United States and worldwide (excluding a small number of countries such as China and Iran). Unless otherwise noted, my report will focus on the worldwide market because competition among ad exchanges occurs at the global level. Next, I discuss the relevant product markets as defined by Professor Lee.

---

into the ad server. So it's winning across free bid at a dollar, and the bid through OB goes in at $0.95.") and 113:17–20 ("It has also become a dynamic with the demand side of the business where DSPs are choosing to buy through Open Bidding less because of the 5 percent fee, amongst other reasons."); *see also*, Deposition of John Dederick (The Trade Desk), July 28, 2023, 189:5–190:3 ("Q…And from our experience, what exchanges have those sell-side fees that you view as problematic?...A….And what we know, in retrospect, is that things like open bidding were happening and open bidding introduced a 5 percent fee to the transaction. And in the view of many of the advertisers that I talked to and agencies that I talked to didn't add any value for the advertisers or for the publishers, it was just 5 percent for Google and that is a pattern of practices, that is, what we think of as sort of a blank check.").

III.A.1. Markets for Ad Tech Tools

63. Professor Lee's Report defines a set of relevant antitrust markets for publisher ad servers, ad exchanges, and advertiser ad networks.[89] I have reviewed his analysis and adopt his conclusion that these are relevant antitrust markets for the purpose of assessing Google's alleged anticompetitive conduct. I also adopt Professor Lee's conclusion that Google has substantial and sustained market power in the market for each of these ad tech tools.[90]

64. There are a number of factors that contribute to Google's market power across the entire ad tech stack, and not all of those factors are specific to the market for individual ad tech tools. Some of the assets that differentiate Google from its competitors across the ad tech stack are: (i) Google's unique owned and operated ("O&O") inventory generated by Search and YouTube; (ii) its Google Ads advertisers, many of whom purchase Google's O&O inventory through its proprietary tools; (iii) the data that Google amasses on users across all of its businesses; and (iv) Google's publisher clients on DFP.[91] As one Google executive noted in a 2017 email, "the value of Google's ad tech stack is less in each individual product, but in the connections across all of them**.**"[92] In communications with regulators, industry participants have also expressed their belief that Google has "dominance across the ad tech stack," which benefits Google "to the detriment" of its competitors.[93]

65. In this report, I estimate the prices that Google would have charged for its publisher ad server and ad exchange products but-for its exclusionary conduct. The remainder of this sub-section

---

89 *See* Lee Report, Sections IV.C.–IV.E.

90 *See* Lee Report, Section V.

91 *See* Lee Report, Section V.A.1.

92 GOOG-DOJ-04830048, at -048 (09/05/2017) ("The value of Google's ad tech stack is less in each individual product, but in **the connections across all of them.**") (emphasis in original).

93 TTD_DOJ-GOOG23-0001957, at -966–67 (02/03/2022) ("Google's integration of its publisher ad server and SSP/ad exchange into Google Ad Manager ("GAM") has benefitted Google to the detriment of competitor DSPs like TTD. We understand that GAM has unrivalled visibility in terms of bids submitted and actual clearing prices. Further, because of its dominance across the ad tech stack, Google is uniquely positioned to amass data points on the buy- and sell-side to combine with its own first party data from Google products, properties, and services to further bolster its competitive advantage, including its understanding of a user or ad impression. We believe that these advantages, certain of which are summarized below, have driven customers to not just GAM, but also Google's DSP, DV360.").

b. Both publisher ad servers and DSPs function as complements to ad exchanges, rather than substitutes.[107] DSPs (and, to a lesser extent, advertiser ad networks) provide a set of tools for advertisers to manage a campaign that may include purchases across several digital advertising formats in addition to open web display ads.[108] Publisher ad servers are the "decision engine" that a publisher uses to allocate each impression to a particular sales channel.[109] Ad exchanges sit between these demand- and supply-side tools, manage the RTB auction process, and facilitate matching of demand and supply by providing integration with and access to a large number of different publisher ad servers and DSPs.

c. In principle, advertisers and publishers might seek to "disintermediate" ad exchanges through direct connections between a DSP and a publisher ad server. In practice, this approach is difficult to scale (it would lack the indirect network effects of an incumbent exchange) and various efforts to take such an approach have remained small compared to established ad exchanges.[110]

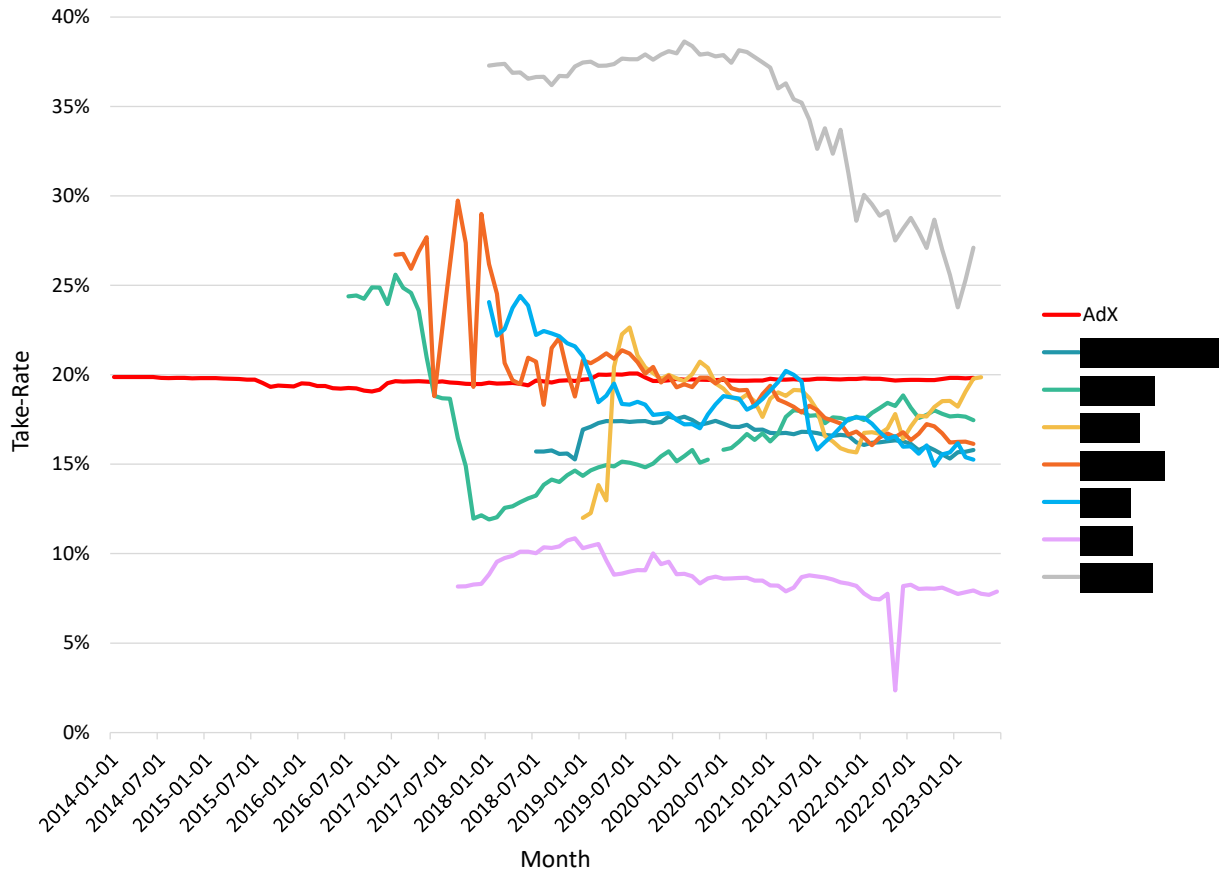
72. Ad exchange prices are generally expressed as a percentage of the total price of transactions between advertisers and publishers. Using data produced by Google and a number of third-party ad exchanges, I have investigated prices (i.e., take rates) and transaction volume in the ad exchange market.

73. Figure 4 shows the average take rate (net revenue divided by gross revenue) for several ad exchanges. The length of the time-series for each exchange in the figure depends upon the amount of monthly data produced by that exchange. The take rates are calculated over impressions in the relevant antitrust market as defined by Professor Lee.

---

[107] *See* Lee Report, Section IV.D.1.
[108] *See* Lee Report, Section II.B.2.
[109] *See* Lee Report, Section II.B.1.
[110] *See* Lee Report, Section VII.

FIGURE 4: EFFECTIVE TAKE RATE FOR WORLDWIDE OPEN WEB DISPLAY + VIDEO OUTSTREAM IMPRESSIONS



Source: Brattle Analysis of monthly AdX and third-party exchange data. See Exchange Figures workpaper.

Notes: I calculate the take rate for each exchange as the fees collected by any given exchange divided by total advertising spending through that exchange on a monthly basis. I exclude from this figure exchanges whose produced data was insufficient to calculate either total advertiser spending or total fees collected by the exchange. See Appendix C.2.

74. AdX's average take rate has remained very close to 20 percent for the entire period from January 2014 to March 2023.[111] The take rates of third-party exchanges have generally trended

[111] This does not imply that Google charges 20 percent for the publisher ad server and exchange on every transaction, or to every publisher. Google has signed some revenue sharing "deals" with a handful of large publishers that effectively set AdX's take rate for those select publishers somewhat below 20 percent. *See, e.g.*, GOOG-AT-MDL-007366628, at -655 (04/2020) [redacted] However, the aggregate data show that overall impact of those deals is relatively small.

78. In addition to these figures, several other types of evidence support the conclusion that Google has market power in the ad exchange market.[114]

a. Because the key function of an ad exchange is to match buyers and sellers in the programmatic indirect channel, indirect network effects provide an important source of competitive advantage. Buyers are attracted to an exchange with more sellers, and vice versa. Google's scale advantage is therefore a source of market power.[115]

b. A driver of Google's scale advantage comes from AdX's exclusive access to Google Ads' advertisers. Because Google Ads submits bid almost exclusively through AdX, third-party exchanges cannot access this large group of buyers.[116] That, in turn, makes AdX a more attractive exchange for publishers that see Google Ads advertisers as a likely source of bids for a particular impression.[117]

c. Google has taken actions that degrade the quality of AdX for publishers. In particular, Google does not submit real-time bids from AdX into publisher ad servers other than DFP.[118] Although this makes AdX less attractive to publishers using non-DFP publisher ad servers, Google has sustained its relatively high take rates and volume growth, which is consistent with the idea that Google possesses market power in the ad exchange market.[119]

III.B. Open Web Ad Impressions

79. There are different types and categories of digital advertising. These categories include: search advertisements delivered in response to user queries; in-stream video advertisements that resemble traditional television commercials; social media ads that appear within the "feed"

---

[114] I take note of Professor Lee's explanation why it is *sufficient* to have market power on either the publisher or the advertiser of the ad exchange market to be able to exert market power in this market. *See* Lee Report, Section III.

[115] *See* Lee Report, Section V.A.2.

[116] *See* Lee Report, Section II.C.3.a.

[117] *See* Lee Report, Section VII.B.

[118] *See* Lee Report, Section V.C.3.

[119] *See* Lee Report, Section VIII.A.

delivered to a user; sponsored listings that appear on e-commerce platforms; and in-app advertisements that appear within a specific application on a mobile device.[120]

80. Open web display advertisements are display ads delivered along with a web page within a user's browser on a personal computer or mobile device. This format is referred to as "open web" because procurement and delivery is managed through the ad tech stack rather than through proprietary tools associated with a particular publisher like Meta or Amazon or a particular function (*e.g.*, search), and because it is delivered within a web browser as opposed to a mobile app. Within the digital advertising ecosystem, open web display advertising is recognized as a distinct and important advertisement format.[121]

81. From a publisher perspective, open web display advertising is distinctive because it does not require a website to have specific functionality.[122] Publishers of web sites that do not have particular content and features, such as general search and shopping, would find it difficult to substitute alternative digital ad formats for open web display advertisements. From an advertiser perspective, display advertising is distinctive because it reaches a large and diverse group of users in an environment where the use of standardized tools and formats leads to increased competition among publishers.

82. Many publishers sell open web display ad impressions through the programmatic indirect channel, and even the largest publishers are very small relative to the total quantity of open web display advertising.[123] In general, individual publishers can influence the price of impressions displayed on their own sites by adjusting content, improving targeting, or making other changes that improve a site's quality as perceived by advertisers. But publishers' price-setting power in the open web display market is ultimately limited by competition. Any publisher that seeks to

---

[120] *See* Lee Report, Section II.A.

[121] *See* Lee Report, Section IV.B.

[122] For example, Google Search sells advertisements that are related to the users' search terms, offering a unique means of advertising that is not available to all website publishers. Likewise, video hosting sites such as YouTube benefit from the ability to display video ads prior to the video that the user wishes to view. Shopping websites, social media websites, and application developers may also have unique advertising opportunities that do not generalize to all web-based publishers. *See* Lee Report, Section IV.B.1.a.

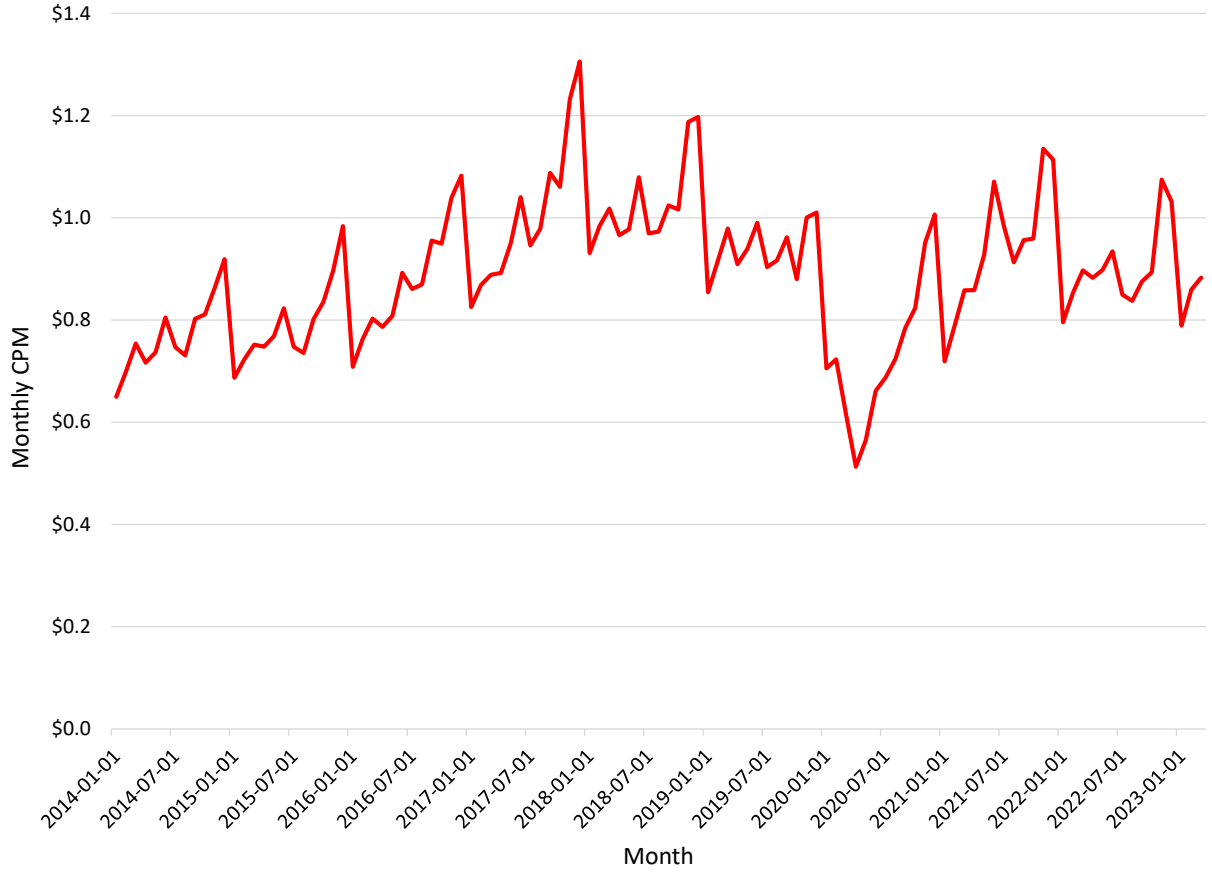
[123] For example, in 2022, the ten largest publishers accounted for 11.5 percent of the total impressions on AdX. *See* AdX Publisher Impression Shares workpaper.

raise its prices by restricting the number of impressions it offers or increasing the floors in its auctions, will find that advertisers can generally substitute to impressions purchased from some other publisher.[124]

83. Figure 7 illustrates the average price of worldwide open web display impressions purchased on AdX. Specifically, I have used data provided by Google to calculate the monthly average advertiser spend per impression for open web display impressions served to worldwide users between 2014 and 2023. During this nine-year time-period, the average advertiser spend per US open web display impression has fluctuated between $0.51 and $1.31, while mostly remaining in a range between $0.80 and $1.00. There is strong seasonal variation, with prices increasing in November and December, during the holiday shopping period, before falling in the first few months of each new year. CPMs also declined in 2020, at the height of the COVID-19 pandemic, when increased internet use led to a larger supply of impressions for sale.

[124] In economics, an industry characterized by a large number of independent producers of differentiated products with low barriers to entry is called *monopolistically competitive*. In this type of competition, product differentiation allows producers to raise prices above marginal cost, but entry and competition drive long-run economic profits to zero. Besides ad publishing, common examples include restaurants and clothing.

FIGURE 6: ADX ADVERTISER SPENDING PER 1,000 WORLDWIDE IMPRESSIONS

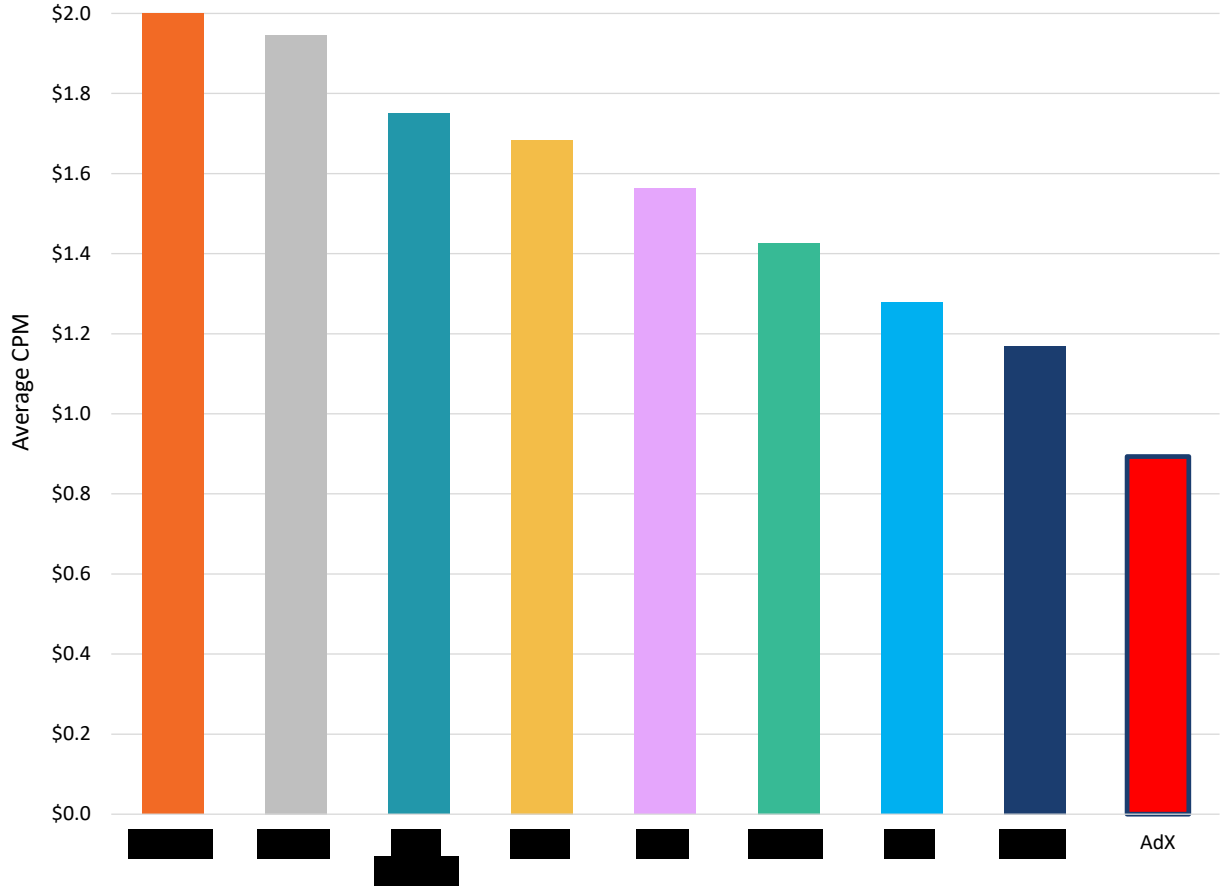


Source: Brattle Analysis of monthly AdX exchange data. See Exchange Figures workpapers.

Notes: Advertiser spend per impression calculated as total advertising spending through a given exchange divided by the total number of impressions associated with that spending. See Appendix C.2.

84. Figure 7 shows the average price per worldwide open web display impression sold on several different ad exchanges between 2018 and 2021. There is substantial dispersion, with a high CPM of $2.01 for [redacted] and low CPM of $0.89 for AdX.

FIGURE 7: AVERAGE SPEND PER 1,000 WORLDWIDE IMPRESSIONS, 2018-2021



Source: Brattle Analysis of monthly AdX and third-party exchange data. See Exchange Figures workpaper.

Notes: Advertiser spend per impression calculated by exchange as total advertising spending through a given exchange, divided by the total number of impressions associated with that spending. Values are average monthly CPM by exchange over the exchange-months in 2018 to 2021. See Appendix C.2.

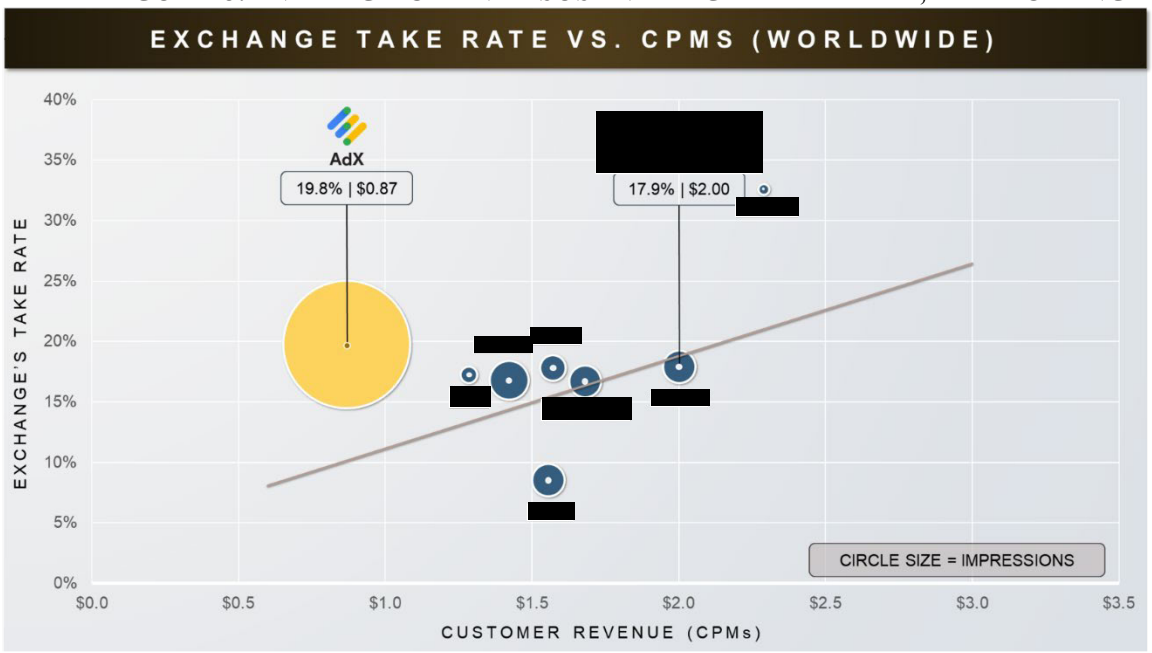
85. The price dispersion in Figure 7 reflects differences in the nature and quality of publisher inventory sold through each exchange, as well as differences in demand, costs and other features of the auction process across the exchanges.[125] Notably, AdX is the only exchange in Figure 7

[125] Deposition of Ryan Pauley (Vox), August 23, 2023, 19:2–17 ("Q. Okay. How did Vox use price floors before UPR?…A. [W]e had different price floors for different SSPs and different partners…We saw it as a way to optimize pricing and optimize yield across our portfolio of inventory by leveraging certain partners for higher priced segments of inventory, leveraging different partners for lower priced segments of inventory.").
In this context, "impression quality" can have different facets, including: the reputation of the publisher, whether the impression is likely to reach a unique or desirable group of end-users, whether there is information that allows the advertiser to specifically target a particular user who values the impression highly, or the size and ad type.

with an average CPM below $1.00. Indeed, comparing Figure 6 to Figure 7 suggests that AdX's large scale and low average CPM have a strong influence on the worldwide average CPM.

86. Figure 8 plots the average take rate of each exchange (as illustrated in Figure 4) against the average CPM of impressions sold through that exchange. Each circle corresponds to an exchange, and the size of the circle is proportional to the impressions of the corresponding exchange. The gray line is based on a linear regression that measures the relationship between average CPM and average take rate for all exchanges other than AdX.[126]

FIGURE 8: AVERAGE CPM VERSUS AVERAGE TAKE RATE, BY EXCHANGE



Source: Brattle analysis of monthly AdX and third-party exchange data. See Comparables workpaper.

Notes: I calculate each exchange's take rate as the sum of their net revenue between January 2019 and March 2023 divided by the sum of their gross revenue during that same period. The best fit line for non-AdX exchanges is estimated via a linear regression of take rate on CPM, weighted by each exchange's total in-market impressions between January 2019 and 2023. I exclude from these calculations exchanges who did not provide data on any of impressions, net revenue, or gross revenue, or exchanges whose data is exclusive to US rather than worldwide impressions. See Appendix C.2.

[126] The regression specification is $TakeRate = \alpha + \beta \cdot CPM$. Each exchange is weighted by its total impressions from January 2019 through March 2023 (though weighting by revenue produces similar results).

87. The gray line in Figure 8 shows that, among all non-AdX exchanges, there is a positive correlation between average CPM and average take rate. That is, exchanges with a higher take rate have a higher average CPM.[127] Indeed, extrapolating from the linear regression model, AdX's predicted take rate, based on its average CPM, would be 10 percent, or about half of its actual 19.8 percent take rate. To understand the factors that allow AdX to maintain its unusual competitive position (as illustrated in Figure 8), the next sub-section of my report considers Google's business practices in the relevant antitrust markets.

III.C. Google's Exclusionary Conduct

88. Google has been accused of several types of exclusionary conduct that would lead to reduced competition and higher prices. I have reviewed Professor Lee's Report and agree with his conclusion that Google's conduct was exclusionary and resulted in materially higher fees paid by advertisers in the ad exchange market above the competitive rates that would have been paid but-for Google's conduct.[128] The following figure summarizes several types of exclusionary conduct

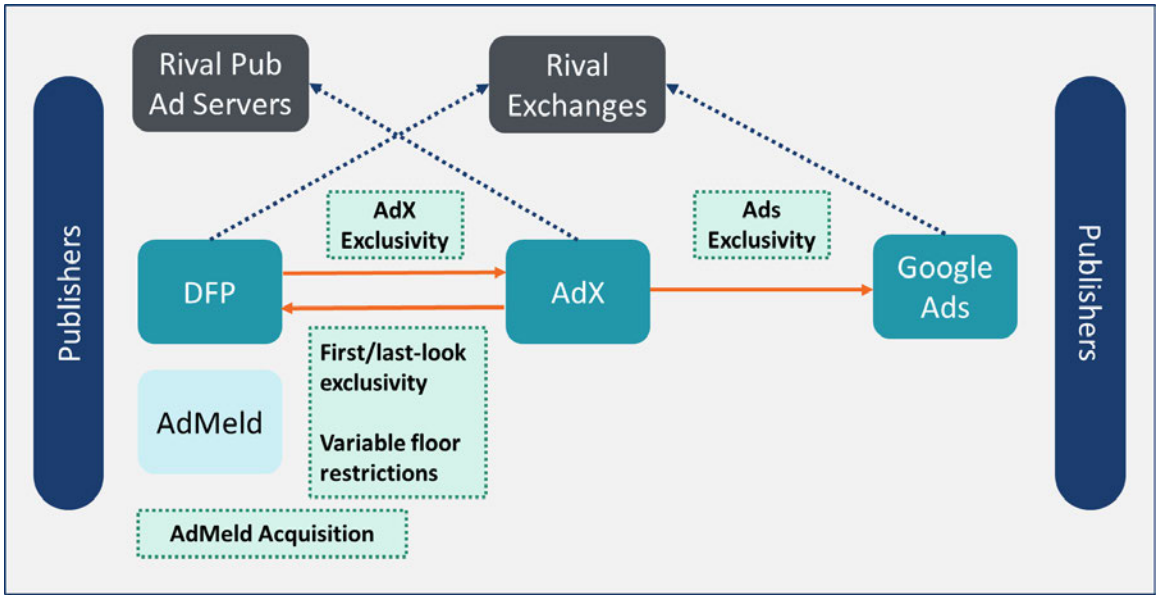
---

[127] This makes sense, because high average CPM is desirable to publishers, so exchanges with higher average CPMs will be less likely to have to negotiate and decrease their take rates to win publishers. And evidence shows these negotiations are a reason exchanges lower their take rates. *See, e.g.*, Deposition of Ryan Pauley (Vox), August 23, 2023, 14:13–15:17 ("Q. Okay. Why is it that Vox has been able to negotiate lower rev shares from exchanges that were not AdX, but not been able to negotiate a lower Open Auction rev share for AdX?... A. In my opinion, I don't know the direct motivations of any other SSPs. But in my opinion, the - there is - we have other alternatives for, you know, SSPs that drive a smaller amount of Open Auction display revenue. Q. And why is that? A. There seems to just be more...SSPs and ad technology partners that, you know, are playing in that - or can compete at that, sort of, smaller range. We have - and, thus, we can - you know, if we get a better - at Vox Media, have a more favorable rev share with one partner, you know, we can drive more business in their direction. So there is more competition. Q. So I think you said there is more competition for the exchanges that have a smaller share; is that right? A. That's correct."); *see also*, Deposition of John Gentry (OpenX) October 26, 2023, 92:15–93:7 ("Q. What - based on your experience, what's your belief as to why AdX has been able to maintain the same take rate for the past five years while OpenX has had to decrease its take rate?... THE WITNESS: Google has enormous market power given the scale and size of who they are. Their control of the great amount of inventory that runs across the landscape and other dynamics allows them to tell advertisers - this is in my belief, I'm not in the conversations - that they don't desire to change their fee. And I think that advertiser will still buy with Google. If OpenX were to say, 'We're not going to change our fee, we do not have the same market position that Google has,' then an advertiser could choose to go to one of our competitors and choose to spend on them because they have a lower fee.") and 103:8–11 ("Q…I think you said competition from other exchanges has caused OpenX to decrease its open auction display take rates; is that right? A. Correct, yes.").

[128] *See* Lee Report, Section VIII.A.1.

that Professor Lee has analyzed in his expert report, and summarizes the impact of this conduct at each layer of the stack.[129]

FIGURE 9: DIAGRAM OF GOOGLE'S EXCLUSIONARY CONDUCT



Source: Lee Expert Report, Section I.A.2., Figure 2.

89. This subsection of my report provides an overview of how Google's conduct harms competition at several layers of the ad tech stack. Specifically, I focus on three categories of conduct that correspond to the three orange arrows in Professor Lee's summary figure: (i) tying Google Ads to AdX by submitting bids from Google Ads advertisers almost exclusively into the AdX exchange; (ii) tying AdX to DFP by submitting real-time bids from AdX almost exclusively into Google's publisher ad server; and (iii) preventing DFP users from working with non-AdX exchanges by disabling their ability to set variable price floors in RTB auctions. I focus on these particular pieces of conduct because they occurred (or continued to occur) during the damages period, and because they are conduct that would be absent in the but-for world I consider.

90. The conduct at-issue in this case extends beyond the three categories that I describe here. For example, Google's use of Dynamic Allocation and enhanced Dynamic Allocation provided AdX with a significant advantage over rival exchanges when bidding on inventory made available by

[129] *See* Lee Report, Section VII.

that Google understood that publishers were setting a higher floor for AdX, and thus expected that AdX would be the primary beneficiary of the UPR policy.[150]

III.D. The But-For World

103. A basic principle of antitrust damages is that harm to a plaintiff is assessed relative to a counterfactual "but-for" world where the challenged conduct did not occur. I consider a but-for world where:

a. There is no tie between Google Ads and AdX. Thus, advertisers on Google Ads would be able to use a single buying tool to multihome among exchanges by submitting bids through multiple paths, including other exchanges with take rates lower than the 20 percent currently charged by AdX.

b. There is no tie between AdX and DFP. Thus, AdX advertisers would be able to submit real-time bids into third-party publisher ad servers, making alternatives to DFP more attractive to publishers.

c. Publishers can vary the floors for different exchanges within DFP, thereby exerting pressure on specific exchanges to reduce their take rates in order to win more auctions.

104. Both economic theory and the evidence presented in this case show how these changes would also produce greater competition in the relevant ad tech tool markets. It is my opinion that removing the two ties and ending Google's practice of prohibiting variable price floors on DFP would lead Google to compete by lowering its take rate.

---

[150] *See* GOOG-TEX-00096393, at -395 (06/19/2018) (In a June 2018 email, Google's Nirmal Jayaram wrote: "If we figure out how to equalize floors (i.e., get the Adx floors down), as a buyer, we will start seeing benefits in terms of buying more through Adx and decreasing incrementality on 3PE [third party exchanges]."); *see also*, GOOG-DOJ-AT-00571933, at -933 (08/13/2019) (In an August 2019 email Google employees discussed results from an internal experiment indicating that UPR would cause DV360 to win approximately 31.8 percent more impressions on AdX-web and would lead to a 6.4 percent increase in AdX-web revenue.). Academic research has noted that these restrictions like UPR, referred to as *platform most-favored-nation clauses* "typically raise platform fees and retail prices and curtail entry or skew positioning decisions by potential entrants pursuing low-end business models." Researchers have called for greater antitrust enforcement actions against these sorts of restrictions; *see also*, Andre Boik and Kenneth S. Corts, "The Effects of Platform Most-Favored-Nation Clauses on Competition and Entry" *Journal of Law and Economics* 59, no. 1 (2016): 105–134; *see also,* Jonathan B. Baker and Fiona Scott Morton, "Antitrust Enforcement Against Platform MFNs," *The Yale Law Journal* (2018): 2176–2202.

105. The but-for world that I describe below envisions removing three categories of anticompetitive conduct—the two ties and UPR—that were in place during the damages period, and that continue today. I do not analyze a counterfactual scenario that returns to an earlier point in time and predicts how the relevant markets would have evolved if Google had not engaged in other types of conduct. That does not imply that other types of conduct, including conduct that ended before the start of the damages period, are irrelevant. If Google had not engaged in "first look" and "last look" conduct, for example, it is less likely that Google would have been able to achieve the scale advantages that allowed it to establish and maintain the ties between Google Ads, AdX and DFP, or to impose UPR on publishers. Thus, it is reasonable to conclude that but-for Google's past conduct that produced scale advantages and indirect network effects, Google's ad tech products would face greater competitive pressure today.[151]

106. Finally, I note that evidence produced in this case suggests that Google subsidizes its publisher ad server through its AdX take rate.[152] In the but-for world, there would be greater competitive pressure at both the ad server and the ad exchange layers of the ad tech stack. My analysis considers what would happen to the total take rate charged for both sell-side components of Google's ad tech stack (ad server and exchange), but offers no opinion regarding how Google would allocate its but-for take rate between those two layers.

III.D.1. Exchange Multihoming by Google Ads' Advertisers

107. If Google did not tie the demand from Google Ads' advertisers to the AdX exchange, then those advertisers would have the ability and incentive to multihome by submitting bids to multiple exchanges. There are at least two reasons advertisers would like to multihome in this way if allowed. First, advertisers would seek paths (i.e., combinations of exchange and publisher ad server) that offered a higher probability of winning an impression for a given bid, because the path charged a lower total take rate, and therefore entered a higher bid in the final auction. This

---

151 *See generally*, Weintraub Report.

152 *See* GOOG-DOJ-04004392, at -397 (09/10/2018) ("It's worth noting that our sell-side pricing model is intertwined with our DBM business, because DBM has pursued a hard-bundled low-free strategy, which has helped it grow gross revenue quickly, but which has meant that is profitability depends on maintaining the 20% sell-side margin.").

c. In 2016, Google described its goal for "allow[ing] non-AdX exchanges to compete with realtime pricing from within DFP" is "to provide slightly better value for publishers than header bidding but not so much that it completely cannibalizes AdX."[169]

d. Google expressed concern that "[y]ield managers are disintermediating our access to inventory, inhibiting our overall display strategy,"[170] and declared that "Yield Managers are a threat we need to take *very* seriously."[171]

116. Academic research also suggests that, after the switch from the waterfall to real-time competition in a unified first-price auction, competition between exchanges and publisher ad servers should have been intense, leading to a sharp decline in take rates.[172]

117. In a but-for world where there is no AdX-DFP tie—so publishers could access real-time bids from AdX through other ad severs and tools—Google could respond to increased competitive pressure in two ways. First, Google could improve the perceived quality of DFP by removing features like UPR, which restricts publisher choice and reinforces Google's market power at other layers in the stack.[173] Second, Google could reduce the overall AdX/DFP take rate, so that AdX bids become more competitive across all publisher ad servers and publishers see higher value from choosing DFP.

III.D.3. Variable Price Floors on DFP

118. Google imposed uniform price floors on DFP customers in September 2019 through UPR. Prior to that change, the evidence shows that publishers often set a higher floor for bids submitted

---

169 GOOG-TEX-00117939, at -939 (01/06/2016) ("Demand syndication allows non-AdX exchanges to compete with realtime pricing from within DFP…Our goal for this product is to provide slightly better value for publishers than header bidding but not so much that it completely cannibalizes AdX.").

170 GOOG-DOJ-13252093, at -094 (09/09/2010) ("Yield managers are disintermediating our access to inventory, inhibiting our overall display strategy").

171 GOOG-DOJ-02139596, at -597 (08/26/2010) ("Yield managers are a threat we need to take *very* seriously") (emphasis in original).

172 Stylianos Despotakis, Ramamoorthi Ravi, and Amin Sayedi, "First-Price Auctions in Online Display Advertising," *Journal of Marketing Research* 58.5 (2021): 888–907, https://doi.org/10.1177/00222437211030201.

173 *See* Lee Report, Section VII.D.2.

through AdX. Publishers did this for several reasons, including because they sought to partner with ad exchanges having lower take rates.[174]

119. Google's internal analyses and experiments reflect the economic significance of imposing UPR and show that imposing UPR substantially improved on its ability to win auctions through AdX, to the detriment of rival exchanges.[175] For example:

a. In a September 2018 email, Google's Nitish Korula refers to an experiment indicating that moving to first price bidding and common floors would result in an annual increase of $430 million in gross revenues and $118 million in net revenues, explaining that "the primary benefit here is from lowered unified floors that a first-price auction enables, not 'first price' in itself."[176]

b. An August 201 email, Google's Rahul Srinivasan wrote about "Moving from legacy AdX pricing rules to UPR (which apply uniformly across AdX, Exchange Bidding and Header Bidding)." He said in this email, "This lowers floors on AdX, providing increased access to inventory for buyers… The effect is estimated at a 6.4% increase in value of open + private auction impressions won by AdX and a 32.6% increase in impressions, which are currently blocked due to high legacy pricing floors… This also has a negative effect on external exchange spend, since remnant / header bidding / Open bidding demand previously had no floors applied."[177]

c. An August 2019 email exchange states that "Rubicon and the greater EB community have seen a decline in spend since first price / UPR." [178] [redacted]

---

174 *See* Lee Report, Section VII.D.2.

175 *See* GOOG-DOJ-AT-00571933, at -933 (08/13/2019) ("[I]t seems we now have the rasta numbers for the impact of UPR…With UPR, it seems for DBM… it's winning a lot of impressions…On AdX-web, I see +31.8% impressions, +6.1% value, +6.4% revenue.").

176 GOOG-DOJ-AT-00588455, at -455 (09/06/2018) ("The main thing to remember is that the primary benefit here is from lowered unified floors that a first-price auction enables, not 'first price' in itself.").

177 GOOG-DOJ-09713317, at -318 (08/13/2019) ("This lowers floors on AdX, providing increased access to inventory for buyers…The effect is estimated at a 6.4% increase in value of open auction + private auction impressions won by AdX and a 32.6% increase in impressions, which are currently blocked due to high legacy pricing rule floors…This also has a negative effect on external exchange spend, since remnant / header bidding / Open Bidding demand previously had no floors applied.").

178 GOOG-DOJ-15044036, at -038 (08/21/2019) ("Rubicon and the greater EB community have seen a decline in spend since first price / UPR.").

[redacted] [179]

d. A slide from a September 2019 Google presentation reports that "[f]or AdWords, the avg. publisher floor reduces from $3.31 under legacy floors to $1.01 under UPR" and refers to a "[n]egative effect on [non-Google] SSP spend, since [header bidding/open bidding] demand previously had no floors applied on Ad Manager." [180]

120. Because publishers used variable floors to steer inventory to exchanges other than AdX before Google imposed UPR rules, it is reasonable to conclude those same economic incentives would lead them to do so again in a but-for world without UPR. As I explained above, publishers' reasons for steering demand reflect both idiosyncratic benefits of working with other exchanges and also a desire to place greater pressure on AdX to compete harder by reducing its take rate. [181]

121. When more impressions are sold through rival exchanges, and publishers have more flexibility to seek out low-cost supply pathways, economic theory suggests that Google would have incentives to reduce its take rate. This is the publisher-side version of the advertiser-side incentive that I described above in relation to the tie between AdX and Google Ads. These competitive incentives would be amplified by indirect network effects at the exchange level.

122. Thus, both economic theory and the available evidence of real-world market behavior show that, but for UPR, Google would face pressure to reduce its take rate in order to win more auctions.

123. Finally, although I have described the impacts of each type of but-for conduct independently, I note that market participants' rational incentives suggest that the types of conduct would reinforce one another in practice, leading to even stronger pressures for Google to reduce its stack-wide take rate. For example, but for the series of ties between Google Ads, AdX, and DFP, publishers using alternative publisher ad servers and RTB tools would be able to access demand

---

179 [redacted]

180 GOOG-DOJ-AT-02204351, at -381 (09/03/2019) ("For AdWords, the av[era]g[e] publisher floors reduces from $3.31 under legacy floors to $1.01 under UPR…**Negative effect on 3P SSP spend, since HB/OB demand previously had no floors applied on AdManager**.") (emphasis in original).

181 *See* Section III.D.1.

from Google Ads advertisers. This would increase the likelihood that publishers would choose non-Google publisher ad servers in the but-for world, undermining Google "ownership" of the publisher ad server tag and making it more difficult to maintain and enforce a UPR policy. In the absence of UPR, the evidence shows that third-party exchanges would have a higher win rate, making them more attractive to advertisers and publishers.

III.E. Summary of FAA Purchases

124. I have been instructed by Counsel to estimate a percentage overcharge for advertisers who purchased Google's ad tech tools during the period from January 2019 to January 2023, inclusive. For brevity, I refer to this period as the "damages period" in the remainder of my Expert Report.

125. I understand that the Plaintiffs are seeking damages on behalf of eight FAAs.[182] The FAAs are agencies of the US federal government that purchased open web display advertisements through Google's AdX platform. The FAAs on whose behalf the Plaintiffs are seeking damages are three US Department of Defense agencies—the US Army, US Navy, and US Air Force—and five other US federal agencies: the US Postal Service, the US Census Bureau, the US Veterans Administration, the National Highway Traffic Safety Administration, and the Centers for Medicare & Medicaid Services.

126. The FAAs purchase open web display advertisements to assist with the US federal government's operations. For example, the National Highway Traffic Safety Administration may use online advertising to raise awareness about safe driving practices, while the US Army might advertise to help achieve recruitment targets. The FAAs bid for impressions on AdX in auctions where they compete with other non-FAA advertisers to purchase open web ad impressions. Figure Figure 29 in Appendix C provides some summary statistics about FAA and non-FAA impressions. From this figure, I calculate the stack-wide take rate for FAA impressions sold through AdX to be 24.6 percent during the damages period.[183]

---

[182] Complaint ¶ 278, ECF No. 120.

[183] *See* Figure 29.

127. My estimate of the percentage overcharge is based on an analysis of how Google's conduct impacts prices paid by all advertisers in the display advertising market. I understand that the FAAs have a wide range of advertising needs, and, like most other large advertisers, work with advertising agencies to develop and implement their open web display ad purchasing strategy. Based on the fact that FAAs and other open web display advertisers use the same tools and processes to participate in RTB auctions, I treat the FAAs as a "representative advertiser" in my analysis below.

IV. Framework for Estimating FAA Overcharge

128. One common measure of antitrust damages is the overcharge.[184] An overcharge can be measured on either a per-unit or a percentage basis. On a per-unit basis, overcharge damages can be written in the form of a simple equation as follows:

Damages = (Actual "As-Is" Price – "But-For" Conduct Price) * Quantity Purchased

This equation says that the total overcharge damages are equal to the difference between the price a plaintiff actually paid and the price that plaintiff would have paid, but for the defendant's conduct, multiplied by the quantity that was actually purchased by the plaintiff.

129. The preceding formula works well for computing overcharge damages for commodity products, where the price and quantity associated with each transaction are relatively easy to measure. For products such as ad tech tools, where price varies from one transaction to the next, the overcharge calculation can be reformulated as follows:

Damages = % Overcharge * Total Expenditures

[184] *See* John M. Connor and Robert H. Lande, "Cartel Overcharges and Optimal Cartel Fines," Chapter XX, Competition Law and Policy (2008), 1 ("[T]he size of the overcharge should be a critical factor in determining the optimal antitrust fine.").

The two formulas are mathematically equivalent.[185] In practice, however, it can be easier to calculate total expenditures and the average percentage overcharge than to identify a specific but-for price paid for every transaction.

130. Overcharge damages represent a transfer from the buyer to the seller. They do not measure the total harm caused by the exclusionary conduct. There is often additional harm in the form of surplus from sales that would have occurred in the but-for world, but do not occur in practice. Nevertheless, the overcharge does compensate the buyer for the difference between actual and competitive prices on all units actually purchased.

131. I have been asked to calculate the percentage overcharge that FAA advertisers incurred due to Google's conduct in the relevant antitrust markets for ad tech tools. I understand that Dr. Respess will calculate the FAA's total expenditures and use my estimate of the percentage overcharge to calculate monetary damages incurred by the FAAs.

132. My analysis focuses on the overcharge associated with the AdX ad exchange and the DFP publisher ad server. Because the as-is price for AdX and DFP is expressed as a take rate, the but-for price that I estimate below is also expressed as an *ad valorem* fee applied to the purchase price of each impression.[186]

133. In Section II.B.2, I explained how the cost of an *ad valorem* tax is shared between buyers and sellers of a product or service, because the buyers pay more and the sellers receive less than they would without the tax. Economic models of tax incidence provide simple formulas for the buyers' and sellers' share of the total tax. Those formulas depend on the slope of the supply and demand curves for the underlying product.[187] This section of my report describes an economic model of tax incidence that can be applied to the AdX take rate to apportion the overcharge

---

[185] This is because the percentage overcharge equals the average overcharge, divided by the average as-is price, and total expenditure is quantity purchased, multiplied by the average as-is price.

[186] As I explained in Section II.B.1, DFP charges other fees for serving direct impressions, and to the extent those prices also reflect the market power associated with Google's exclusionary conduct, my overcharge estimates are conservative. My estimate includes only open web display advertising transactions conducted on AdX, for which DFP fees are "waived," given the 20 percent AdX take rate.

[187] As explained below, the true economic cost of the tax to each party depends on the elasticities of each party, rather than the party on whom the tax is actually levied.

between advertisers and publishers. The model requires estimates of the slope of the supply and demand curves for open web impressions sold on AdX as inputs.[188]

134. The steps in my advertiser overcharge calculation are summarized in the following figure.

FIGURE 10: OUTLINE OF OVERCHARGE ESTIMATION

1		**Estimate total overcharge.**
2		**Estimate the proportion of the total overcharge paid by advertisers.**
	2a	Estimate the price elasticity of AdX advertiser demand for AdX impressions.
	2b	Estimate the price elasticity of supply for impressions sold to AdX advertisers.
	2c	Combine estimates from steps 2a and 2b using the model of tax incidence to calculate the share of the total overcharge incurred by advertisers.
3		**Combine the total overcharge from step 1 and the advertiser share from step 2c to calculate total percentage overcharge paid by FAAs.**

135. The remainder of this section explains each of these steps in more detail. First, in Section IV.A, I explain two approaches that I use to estimate the but-for take rate. Then, in Section IV.B, I explain the tax incidence framework used for apportioning the total overcharge, and the methods that I use to estimate the inputs to that model.

IV.A. Methods for Estimating But-For Take Rate

136. I consider two different methods to estimate the but-for take rate: comparables and an event-study regression.

IV.A.1. Comparables Approach

137. The comparables method is a commonly used approach to estimate damages in a variety of contexts.[189] The basic idea behind this methodology is to find transactions that were not

[188] In this section, I present the framework for my overcharge model by reviewing the economic theory of *ad valorem* taxes. I do this because the economic theory used to analyze other *ad valorem* fees is frequently applied to analyzing the effect of taxes, and because consumers commonly experience *ad valorem* fees through paying taxes. However, AdX's fee is not, strictly speaking, a tax.

[189] *See, e.g.*, National Research Council of the National Academies, "Reference Manual on Scientific Evidence: Third Edition," *National Academies Press*, accessed December 17, 2023,

influenced by the relevant conduct and use the price of those transactions as a benchmark to estimate the counterfactual but-for price that would have been paid in transactions that were influenced by the relevant conduct.[190] The comparables approach is sometimes referred to as the "market approach" because it relies on the market price of arms-length transactions as its primary form of evidence.

138. The comparables method proceeds in five steps:

1. Identify characteristics of a transaction useful for assessing comparability,
2. Based on relevant characteristics, choose a set of comparable transactions,
3. Select weights or multiples so that each comparable is appropriately scaled,
4. Calculate a weighted average price for the comparable transactions, and
5. Compare the as-is price to the but-for price calculated in the previous step.

139. For the first step in the comparables approach, I use the characteristics of open web display advertising transactions, as described in Section III.A.1 above. I focus on impressions displayed to worldwide users, though I also perform my analysis on impressions displayed to US users as a robustness test. I exclude impressions that are not in the relevant market, including impressions sold via the direct channel, as well as a variety of advertising formats such as search advertising, social media, instream video, in-app, and ads served within the "walled gardens" owned and operated by large publishers such as Amazon or Facebook.[191]

140. For the second step in the comparables approach, I select all transactions where an advertiser pays an ad exchange other than AdX for serving an open web display impression. Although these transactions are selected based on characteristics of advertising impressions, the relevant price is the take rate charged by the ad exchange for facilitating the transaction between a publisher and advertiser.

---

https://nap.nationalacademies.org/read/13163/chapter/10; *see also*, Rosa M. Abrantes-Metz and Alberto D. Metz, "How to Approach the Calculation of Overcharge by Multisided Platforms," *Competition Policy International*, January 2023, https://www.brattle.com/wp-content/uploads/2023/02/How-to-Approach-the-Calculation-of-Overcharge-by-Multisided-Platforms.pdf.

[190] The comparables approach is analogous to econometric estimation of "treatment effects" by comparing a treated group of transactions influenced by certain conduct to a control group that was not affected by the conduct.

[191] *See* Appendix C.

141. For the third step, the choice of weights will typically depend on the data that is available. In this case, I have access to data produced by Google and several other ad exchanges. For each non-Google (or "third-party") exchange I observe the monthly gross and net revenues, as well as the total number of impressions sold each month. This allows me to calculate the average take rate (which equals net revenue divided by gross revenue) for each month. The third-party exchange data I rely on do not provide information about prices or take rates at the level of the individual impression.[192] Thus, I must compare the average take rates across different ad exchanges, as opposed to comparing take rates charged for comparable impressions.

142. Given the data available to me, I use gross revenue weights to calculate the weighted average take rate for third-party exchanges. An exchange's gross revenue weight corresponds to its share of the total gross revenue collected from advertisers by all comparable exchanges between January 2019 and March 2023.[193]

143. Gross revenue weights are one appropriate choice for two reasons. First, the weights ensure that "more important" exchanges (which sell more impressions or have higher average CPMs) exert more influence on the but-for price. Without weights, a relatively small exchange would have the same impact on the average take rate as a much larger one.[194] Second, gross revenue weights ensure that the weighted average take rate calculated in the final step of the comparables analysis is equal to the market-wide average take rate for all comparable transactions.[195] Because AdX serves a substantial share of the entire open web display market, its transactions will necessarily include a wide range of publishers, advertisers, and internet users. Using gross revenue weights

---

[192] I understand that some third-party exchanges have produced impression- or bid-level data, but that these data do not cover as many exchanges, and they cover shorter time periods than the aggregate data that I use as inputs to my analysis.

[193] I chose this time period because it overlaps the damages period and is the longest span of time for which it is possible to construct a "balanced panel" consisting of eight exchanges, including AdX, given the data produced.

[194] For example, consider a case in which several general-purpose exchanges collectively account for 90 percent of gross exchange revenue and have a 14 percent take rate, while an equal number of smaller, specialty exchanges account for only 10 percent of gross exchange revenue and have an 18 percent take rate. Weighting the average take rate by gross revenue would result in an overall average take rate of 14.4 percent, while the unweighted average take rate would be 16 percent.

[195] In mathematical terms, $\sum \tau_i \cdot w_i = \frac{\text{Total Net revenue}}{\text{Total Gross revene}}$, because $\tau_i = \frac{Net\ Revenue_i}{Gross\ Revenue_i}$ and $w_i = \frac{Gross\ Revenue_i}{Total\ Gross\ Revenue}$

146. Ad exchanges and publisher ad servers are differentiated products. Professor Lee's report describes a number of features that differ across rival ad exchange and publisher ad server implementations,[200] though the core features of an ad exchange such as running real-time auctions between demand sources are present in all modern ad exchanges. Google documents also indicate that they understand their ad tech tools to be differentiated products.[201] Moreover, it is clear that ad tech tool suppliers compete by setting take rates, rather than choosing the number of impressions they will serve. This establishes that the ad exchange and publisher ad server markets are examples of differentiated Bertrand competition. I therefore expect that prices – that is, take rates – in those markets are strategic complements.

147. The notion that AdX's take rate and the take rates for other exchanges are strategic complements is further supported by Google's internal analysis. Google documents indicating concerns about fierce competition and "commoditization" of the ad exchange market support the idea that a reduction in Google's take rate would lead other exchanges to follow suit. [202] When considering the threat posed by header bidding, for example, Google employees discussed the "other value that [AdX] provides,"[203] and noted that the commoditization of the "traditional" ad exchange would drastically reduce take rates among ad exchanges, potentially driving take rates as low as five percent.[204]

---

200 *See* discussion in Section II and Appendix F; s*ee also generally* Lee Report, Section II.B.

201 For instance, *see* GOOG-DOJ-14826585, at -596 ("Approximately 13 features represent the current delta between AdX and competitors").

202 GOOG-TEX-00106259, at -260–61 (11/04/2017) (Payam Shodjai proposing a 5% AdX rev share for Authorized Buyer demand and undifferentiated DV360 demand, or DV360 demand without proprietary Google data and targeting); GOOG-DOJ-32034896, at -896 (06/20/2018) (Aparna Pappu proposing that for Google's AdX product "[f]or all programmatic i.e. transactions including AdX and EB – sellside charges for taking on risk of being a clearing house so whatever 2% to 10% whatever we think the market can bear but ideally closer to 2%.").

203 GOOG-DOJ-10634461, at -466–468 (09/02/2016) ("There is some other value that ADX (and Jedi) provides beyond protections, etc - unified reporting and clearing are other examples. Because of all that those benefits, I still think that ADX would have value even in a world where there was a neutral bare-bones uber-exchange. I think the best outcome is that we own the 'uber-exchange' and can charge for it, but some partners may just never trust us no matter how fair or open we are. I agree with your conclusion that client-side or server-side doesn't matter much to buyers from a technology perspective - it is more about what they get with each option - eg, client side they get more independence from Google, reduced fees, get around EDA.").

204 GOOG-DOJ-10634461, at -465–466 (09/06/2016) ("My conclusion is that there are three threats to our open auction/remnant business from essentially commoditization of the traditional SSP. [A]) We lose advantageous access to the inventory [B]) We (dbm+gdn) are left with no/disadvantaged access [C]) Our AdX buyers move away[.] I am of the opinion that (A) already happened . . . only question is whether we want to slow it down

148. Strategic complementarity implies that Google's *current* supracompetitive take rate encourages other exchanges to raise their own take rates above the level that would prevail in a competitive equilibrium. Therefore, any market-wide competitive take rate estimated from existing as-is take rates of non-AdX exchanges is likely an overestimate (i.e., conservative) relative to the market-wide competitive take rate that I would estimate but-for Google's conduct. Moreover, because strategic complementarity implies that third-party exchanges would reduce their own prices in the but-for world, Google could still benefit from product differentiation that is not linked to its exclusionary conduct. Put differently, I do not have access to the ideal data for a comparables analysis – because Google's conduct affects the take rates of other exchanges in the real world – and this leads to conservative estimates of the but-for take rate. Moreover, because strategic complementarity implies that third-party exchanges would reduce their own prices in the but-for world, Google could still benefit from product differentiation that is not linked to its exclusionary conduct.

IV.A.2. Event Study Approach

149. In September 2019, Google's adoption of UPR imposed restrictions on publishers' ability to submit auctions with price floors that varied by demand source. Google's own analysis suggested that, although UPR upset its publisher customers, it also led to AdX winning many more impressions (without reducing its 20 percent take rate).[205] Section III.A.1 describes how Google's ability to impose UPR on publishers who had already revealed a preference for setting variable price floors is an indication of the degree of market power created by the ties between

---

further . . . As such let's really focus our attention on (B), which would help with (C) but sadly the latter might not be sustainable either….Now going back to Chris' points around policy, and buyer level enforcement. I don't think Publishers would allow a massive proliferation of participants in the HB (AKA client side Auction) ecosystem. The end game would be a mix of SSPs, few niche buyers ("networks") like CRTO, FAN, Amazon and *maybe* some hybrid DSPs. All of them would essentially offer the same value to the publisher but might have different policies, which are primarily designed to protect their buyers. As such I think these pieces gets commoditized, so we probably can charge 5%-8% for all these services Chris and Jim cite. [let's call them X]… Now you enter Ali's idea to do transparent 1st price auction, this is a solution to a different problem (let's call it Z), i.e. how AdX should be competing with other SSPs to have more of the independent small DSPs incentivized to buy through AdX. It's also a way to protect DBM/GDN from buying the same inventory through other SSPs.") and at -464 (09/04/2016) ("I agree with the analogy, indeed an exchange shouldn't be an immensely profitable business, it's like a public good used to facilitate buyers and sellers. As we discussed many times, if we started all over again I would conclude that sell side margins are higher than a natural equilibrium and buy side margins are too low. Moreover the real value in sellside margins come from X+Y+reservation functionality. ").

[205] *See* Appendix H.1.

Google Ads, AdX, and DFP. In the but-for world, Google would not possess this market power, and its take rate elasticity of demand would be closer to what other exchanges face in the as-is world.

150. The preceding discussion suggests a thought experiment: If Google's customers were just as price sensitive as the customers of other exchanges, because Google lacked the market power that stems from certain of its prior conduct, how much would Google have needed to reduce its take rate to have attained the same increase in transactions as it gained through UPR? Subtracting the "UPR equivalent take rate" from Google's as-is 20 percent take rate would provide an alternative data point for the possible take rate that Google would charge in the but-for world. Ultimately, this analysis provides a (partial) measure of the effect of the conduct in which Google engaged in the as-is world, but not in the but-for world.

151. It is possible to estimate the UPR-equivalent take rate using an "event study" regression model combined with the data produced by Google and third-party exchanges. The event study regression takes the following form[206]:

$$\ln(Q_{it}) = \delta_i + \gamma_t + \rho \times isGoogle_i \times UPRImpl_t + \alpha \times isGoogle_i \times LRUPR_t - \beta\tau_{i,t} + \varepsilon_{i,t}$$

where,

i: identifies the exchange and t identifies the month.

$Q_{i,t}$: is the number of impressions sold on exchange i in month t,

---

[206] This regression can be derived from the widely applied discrete choice demand model of Berry (1994). In particular, suppose advertiser i seeks to buy an impression with expected price p, and is selecting among several exchanges (indexed by j). The net benefits of buying through exchange j are represented as $u_{ij} = X_i\theta + \xi_i - \beta p(1+\tau_i) + \varepsilon_{ij}$, where X_i and ξ_i are observed and unobserved exchange characteristics respectively; $p(1+\tau_i)$ is the bid required to purchase the impression through exchange j; and the term ε_{ij} reflects idiosyncratic benefits that advertiser i derives on exchange j. Assuming the advertiser chooses the exchange with the highest net benefits, Berry (1994) shows how to move from the choice model to my regression. The outcome variable in his paper is expressed as the log-ratio of market shares, $\ln(S_{it}/S_{0t})$ of the exchanges. In my regression, the share of the outside good, S_{0t}, is absorbed by the month effects and the unobserved exchange characteristics, ξ_i, are captured by the exchange fixed effects.
See Steven T. Berry, "Estimating Discrete-Choice Models of Product Differentiation," *The RAND Journal of Economics* (1994): 242-262.

assumption (a) in the second interpretation, then my estimate is likely conservative due to strategic complementarities.

157. Finally, I note that the introduction of UPR in September 2019 was accompanied by the move to a first-price auction and the removal of the "last look" benefit provided by Dynamic Allocation. Because the removal of "last look" led to a lower win rate for AdX, however, the event study estimates should underestimate the benefits of UPR, and are therefore conservative.[211] Google's internal analysis shows that the switch to first-price auction had little impact on market outcomes.[212] In particular, a September 2019 email from Google's Nitish Korula indicates that the combined changes would produce a substantial increase in revenue for Google, and explains that "the primary benefit here is from lowered unified floors that a first-price auction enables, not 'first price' in itself."[213]

IV.B. Method for Apportioning Total Overcharge

158. This section explains the method I use to apportion the total overcharge between publishers and advertisers.

159. In economics, fees that are equal to a percent of a total sales amount are referred to as *ad valorem* fees. AdX's *ad valorem* fee functions similarly to a tax, creating a "wedge" between the price paid by advertisers and the price received by website publishers. The economic theory analyzing *ad valorem* fees frequently studies taxes, since this is the context in which consumers often have experience with *ad valorem* fees.[214] Many common taxes, such as sales taxes, are

---

211 *See* GOOG-DOJ-AT02204351, at -359 (09/03/2019) ("Removing Last Look* has significant negative impact" slide shows -9.41% impact on Impressions for total AdX only web.").

212 Economic theory suggests that, holding all else equal, the switch from a second-price to a first-price auction format will have no impact on the expected revenue of the seller or the expected payment from the buyer. This famous result is known as the Revenue Equivalence Theorem. (*see, e.g.,* P. Milgrom, *Putting Auction Theory to Work*, Cambridge University Press, Cambridge, 2004.)

213 GOOG-DOJ-AT-00588455, at -455 (09/08/2018) ("The main thing to remember is that the primary benefit here is from lowered unified floors that a first-price auction enables, not 'first price' in itself.").

214 Hal R. Varian, *Intermediate Microeconomics: A Modern Approach*, ed. 2 (New York: W. W. Norton & Company, 1990), 283–284 ("There are several different kinds of taxes that one might impose. Two examples we will consider here are **quantity taxes** and **value** taxes (also called **ad valorem** taxes)…A value tax is a tax expressed in percentage units. State sales taxes are the most common example of value taxes. If your state has a

equal to a fixed percent of a transaction amount; AdX's fee structure is similar, since AdX also typically charges a fixed percentage of the transaction amount when an impression is sold through its exchange. Both the sales tax and AdX fee are therefore *ad valorem* fees. Under this framework, the *incidence* (i.e., the share of harm) of a "tax" on a transaction does not depend on whether it is the buyer or the seller who nominally pays the tax. Rather, the tax burden depends on the relative price elasticities of publisher supply and advertiser demands.[215]

160. Section II.B.2 explained how an *ad valorem* fee such as AdX's take rate resembles a tax. The take rate (or take rate increase) creates a "wedge" between the price paid by advertisers and the price received by website publishers in an open web display advertising transaction. In other words, advertisers pay more and publishers receive less than they would but for AdX's take rate, with the difference going to Google.

161. In this section, I explain the standard framework that economists use to measure the incidence from a tax or *ad valorem* fee. In this tax incidence model, a buyer or seller's share of the total cost of the tax depends on the elasticity (or slope) of the supply and demand curves for the item that is purchased. Section IV.B.1 explains the standard tax incidence model, which can be found in many textbooks, and Section IV.B.2 explains how I adapt that framework to the fees charged in the ad tech stack.

IV.B.1. Tax Incidence Framework

162. The price elasticity of demand captures the change in the quantity demanded when the price of a good changes from some baseline price.[216] Demand is said to be *elastic* when the percent change in quantity purchased exceeds the percent change in price. Demand is considered *inelastic* when

---

5 percent sales tax, then when you pay $1.05 for something (including the tax), the supplier gets $1.00."). (emphasis in original).

215 Hal R. Varian, *Intermediate Microeconomics: A Modern Approach*, ed. 2 (New York: W. W. Norton & Company, 1990), 288 ("[A] tax really shouldn't be regarded as a tax on firms or on consumers. Rather, taxes are on transactions *between* firms and consumers. In general, a tax will both raise the price paid by consumers and lower the price received by firms. How much of a tax gets passed along will therefore depend on the characteristics of demand and supply.").

216 *See* Edgar K. Browning and Jacquelene M. Browning, *Microeconomic Theory and Applications,* 4th ed. (New York: Harper Collins, 1992), 94 ("The price elasticity of demand is a measure of how sensitive quantity demanded is to a change in the price of a product. It can be defined as *the percentage change in quantity demanded divided by the percentage change in price*.").

172. Finally, I note that, although this graphical analysis considers the introduction of a new tax—that is, an increase in the tax rate starting from zero—the conclusions do not change if I consider an increase that starts from some positive rate. Thus, the standard tax incidence framework can be used to analyze advertisers' and publishers' respective shares of the AdX overcharge, which is economically equivalent to an increase from the but-for to the as-is take rate.

IV.B.2. Mathematical Model of Advertiser Overcharge

173. This section of my report adapts the standard tax incidence framework to the setting of ad tech tools and open web display advertising, and describes the equation that I use to estimate advertiser overcharge.

174. My mathematical model for calculating advertisers' share of the total AdX overcharge starts with a set of supply and demand curves. When deciding whether to sell a representative impression through a particular exchange, publishers in theory should weigh the quality adjusted net revenue (i.e., the market price, less take rate fees) they expect to earn through that exchange versus what they could earn from filling their impression through alternative channels (e.g., another exchange via header bidding or a direct deal). The greater the quality adjusted net revenue through the exchange, the more impressions a publisher will auction through that exchange, all else equal. The supply of impressions auctioned through an exchange will therefore increase with the net CPM on that exchange. The elasticity of supply will depend on the value of publishers' outside options for filling their impressions relative to the value of selling through a particular exchange.

175. Advertisers face a similar choice when purchasing impressions. Any given advertiser expects to earn a return on their advertising investment. Thus, for a given type of impression, advertisers should theoretically weigh the price they expect to pay through an exchange's open auctions versus alternative channels for acquiring the same type of impression (or the value they can realize from advertising through alternative channels). The higher is the price that advertisers expect to pay through an exchange, the fewer impressions they will purchase through that exchange, all else equal. The elasticity of demand for a particular exchange will reflect the distribution of value of advertisers' outside options relative to the value of purchasing through that exchange.

1		**Estimate total overcharge.**
2		**Estimate the proportion of the total overcharge paid by advertisers.**
	2a	Estimate the price elasticity of AdX advertiser demand for AdX impressions.
	2b	Estimate the price elasticity of supply for impressions sold to AdX advertisers.
	2c	Combine estimates from steps 2a and 2b using the model of tax incidence to calculate the share of the total overcharge incurred by advertisers.
3		**Combine the total overcharge from step 1 and the advertiser share from step 2c to calculate total percentage overcharge paid by FAAs.**

V.A.1. Comparables Approach

216. Section IV.A.1 explained how the comparables approach is a widely used method for estimating damages that, if applied correctly, will yield a reliable estimate of AdX's but-for take rate. The assumptions and steps for carrying out this analysis were described in Section IV.A.1. This section presents several estimates of the weighted average take rate charged by other exchanges in the as-is world (hereafter referred to as the "market-wide competitive take rate").

217. In order to calculate the market-wide competitive take rate, I rely on the same monthly exchange data for AdX and third-party exchanges summarized in Figure 4 and Figure 5 above.[239] These data are based on worldwide open web display advertising impressions sold between January 2019 (the start of the damages period) and March 2023 (the last month in which data necessary to calculate take rates is available for the majority of exchanges).[240] The eight ad exchanges included in this dataset are AdX, Index Exchange, Magnite, OpenX, Pubmatic, Sovrn, Xandr, and Yieldmo.[241]

218. The data produced by third-party exchanges do not clearly indicate whether their gross or net revenues include the 5 percent fees charged by Google for using AdX Open Bidding. My baseline estimates are based on the conservative assumption that third-party take rates do not include AdX Open Bidding fees.

---

[239] Appendix C.2 describes this dataset in greater detail.

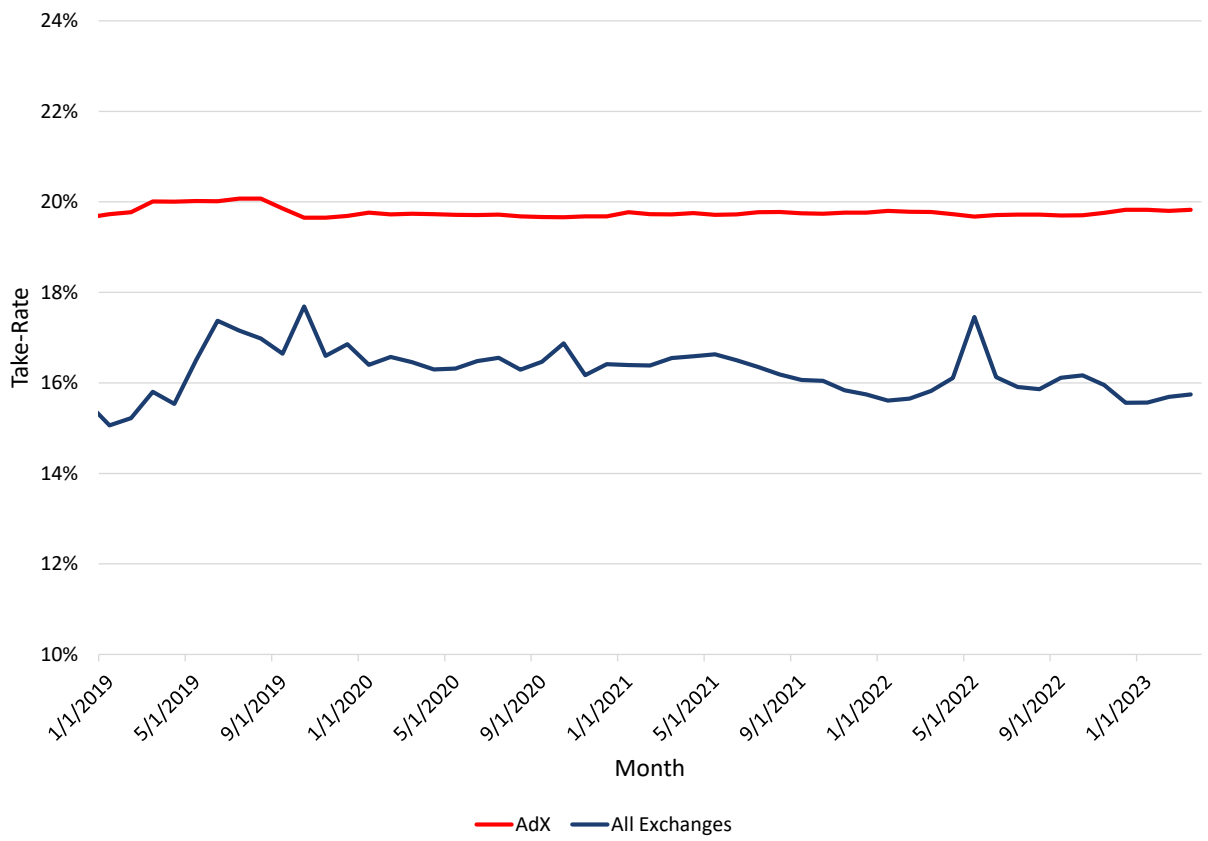
[240] *See* sheet "take_rate" of Exchange Figures workpaper.

[241] I exclude from these calculations exchanges who did not provide data on any of impressions, net revenue, or gross revenue, or exchanges whose data is exclusive to US rather than worldwide impressions. Moreover, I exclude data from Fyber, ironSource, Unity, and Vungle as I understand that they primarily operate auctions for in-app impressions.

219. Because the third-party exchanges have produced data covering slightly different time periods, I begin by constructing a monthly market-wide competitive take rate as follows. First, for each month, I add the net revenue (or fees) and the gross revenue (advertiser spending) of all non-AdX exchanges to obtain the total non-AdX gross and net revenues. Second, within each month, I calculate the take rate separately for AdX and the non-AdX exchanges by dividing total net revenue into total gross revenue.

220. Figure 14 below compares a time series of AdX's take rate to the estimated market-wide competitive take rate. AdX's take rate has remained steady at roughly 19.8 percent. In contrast, my estimated market-wide comparables-based competitive take rate fluctuates between 15.1 percent and 17.7 percent.

FIGURE 14: ADX AND MARKET-WIDE AVERAGE COMPARABLE TAKE RATES



Source: Brattle analysis of monthly AdX and third-party exchange data. See Comparables workpaper.

Notes: I calculate the market-wide average comparable take rate as the sum of net revenue associated with the third-party exchanges divided by the sum of their gross revenue. See Appendix C.2.

221. In Figure 14, the estimated market-wide competitive take rate fluctuates over time for two reasons. First, the take rate of each third-party exchanges changes from month to month.[242] Second, the revenue weights associated with each exchange can fluctuate over time depending on their revenue shares among the non-AdX exchanges.

222. In practice, Google maintains a stable AdX take rate, and I assume that Google would continue to set a stable take rate in the but-for world. To calculate a single market-wide competitive take rate, I aggregate the monthly net and gross revenue values associated for all non-AdX exchanges across all available months. I subsequently calculate a single market-wide comparable take rate by dividing the aggregated non-AdX net revenue into aggregated non-AdX gross revenue.

223. Figure 15 shows the results of this calculation. Between January 2019 and March 2023, the worldwide average take rate for open web display impressions sold through AdX was 19.8 percent. Over the same period, the weighted average take rate for worldwide impressions sold through third-party ad exchanges was 16.2 percent. This implies a total overcharge of 18.2 percent.[243]

FIGURE 15: BUT-FOR COMPARABLE TAKE RATES, WORLDWIDE IMPRESSIONS

Exchange		Take-Rate
AdX	[1]	19.8%
All Third Parties	[2]	16.2%
Large Third Parties	[3]	15.6%

Source: Brattle analysis of monthly exchange-level panel. See Comparables workpaper.

[242] Many short-run fluctuations in third-party exchange take rates reflect idiosyncratic factors that are not material to understanding the overall difference between Google's as-is and but-for take rates. For example, an exchange may negotiate discounts with specific publishers, leading to fluctuations in the average take rate that are driven by that number of impressions served for that advertiser in a particular month.

[243] 18.2% = (19.8% -16.2%) / 19.8%

Notes: Large third parties are those whose total gross revenue constitutes at least 10 percent of total gross revenue among the included third-party exchanges between January 2019 and March 2023. The take rate for each group is calculated as the total net revenue between January 2019 and March 2023 for that group divided by is total gross revenue over the same period. I exclude DCN and Sharethrough from my calculations as their data pertains to US impressions only. I exclude Yahoo and Equativ as their data does not contain values for net revenue.

[1]: Excludes Open Bidding transactions.

[2]: Includes Index Exchange, Magnite/Rubicon, OpenX, Pubmatic, Sovrn, Xandr, and YieldMo.

[3]: Includes Index Exchange, Magnite/Rubicon, OpenX, Pubmatic, and Xandr.

224. In Figure 15, I also show how the results of the comparables approach would change if I exclude two "small" ad exchanges (Sovrn and YieldMo) that each account for less than 10 percent of the total revenue on non-AdX exchanges . For the remaining "large" exchanges (Index Exchange, Magnite/Rubicon, OpenX, Pubmatic, and Xandr) the weighted average take rate based on worldwide impressions is 15.6 percent. In Appendix D, I report additional robustness checks, including a set of weighted averages based on impressions served to a US internet users.

225. In Section IV.A.2, I explained how both economic theory and Google's own internal analysis suggest that the comparables approach yields a conservative estimate of the take rate that Google would charge in the but-for world. Thus, in my view, the estimates reported in Figure 15 provide an upper-bound estimate of the but-for take rate that provides a reliable basis for calculating the damages incurred by the FAAs.

V.A.2. Event Study Approach

226. Section IV.A.2 describes the event study methodology that I use to obtain a second estimate of the AdX take rate that Google would charge but for its exclusionary conduct. This method uses a regression to estimate two key parameters. The first parameter, α, measures the increase in market share that Google achieved by implementing UPR. Because Google could not implement UPR in the but-for world, this parameter provides an indication of the benefits that Google derives from its exclusionary conduct, and the corresponding harm to publishers and

advertisers.[244] To translate that harm into a but-for take rate, I use a second parameter, β, that measures the sensitivity of ad exchange demand to changes in the take rate. The ratio of α to β represents the "take-rate equivalent" impact of UPR.

227. The regression model that I use to estimate α and β is discussed in Section IV.B.2. The data that I use to estimate this model is the same monthly panel of AdX and third-party exchange data that I used for the comparables approach.[245]

228. For the event study, I focus on the time period from October 2018 through September 2021. This period (also called the "event window") includes one year of data prior to Google's introduction of UPR, as well as 24 months after the implementation of UPR. In general, the larger the window on either side of an event, the greater the possibility that unobserved and uncontrolled factors could affect the estimates. For that reason, econometricians generally advise selecting the smallest time window that is large enough to estimate the long-term impacts of an event.

229. Finally, to address the concern that take rates may be endogenous (that is, correlated with the econometric error term) I use the sums of lagged take rates and CPMs of other exchanges as instrumental variables (IVs). Lagged prices and characteristics of other products in the same market have been used as instruments in many other studies.[246] The potential endogeneity of prices of a well-known econometric concern that could lead to biased estimates.[247] Whether endogeneity actually leads to biased estimates in a particular regression is not something that can be determined from the data—it is a theoretical concern. Because my event study model includes a full set of exchange and month fixed effects, it controls for any differences between exchanges that do not change over time, as well as any trends such as overall market growth that have the same impact on all exchanges. While this additional explanatory power addresses potential bias from omitted variables, it does not necessarily mean that the model solves the

---

244 *See* Section III.D for a discussion of Google's ties and UPR. In particular, the but-for world assumes that Google does not tie Google Ads to AdX and AdX to DFP.

245 *See* Section V.A.1 and Appendix C.1 for a discussion of the data.

246 *See* Steve Berry, James Levinsohn, and Ariel Pakes, "Automobile Prices in Market Equilibrium," *Econometrica* 63, no. 4 (1995): 841–890, at 854–855; *see also*, Manuel Arellano and Stephen Bond, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies* 58, no. 2 (1991): 277–297.

247 The basic concern is that unobserved factors that lead to increased demand for a particular exchange (e.g., a marketing campaign or new product feature) could also lead to changes in the take rate for that exchange.

endogeneity problem. Using an instrumental variable (IV) approach alongside the ordinary least squares (OLS) approach employs a different set of assumptions and leads to complementary results.

230. Results for my baseline event study specification are reported in Figure 16. OLS and IV regression estimates for all exchanges are reported in columns [B] and [C]. Columns [D] and [E] report results for the same model using only the "large" exchanges (Index Exchange, Magnite/Rubicon, OpenX, Pubmatic, and Xandr) along with AdX.[248] My estimate of α is based on the "long run" impact, as measured from the first quarter of 2020 through the third quarter of 2021.

FIGURE 16: EVENT STUDY BUT-FOR TAKE RATE ESTIMATION
REGRESSION RESULTS BASED ON INTRODUCTION OF UPR, WORLDWIDE IMPRESSIONS

	(1)	(2)	(3)	(4)
Variables	**OLS**	**IV**	**OLS**	**IV**
[A]	[B]	[C]	[D]	[E]
Google X Implementation Quarter (2019Q4)	0.0714	0.0685	0.136*	0.131*
	[0.0853]	[0.0784]	[0.0799]	[0.0715]
Google X Long Run (2020Q1-2021Q3)	0.192***	0.194***	0.248***	0.247***
	[0.0479]	[0.0440]	[0.0448]	[0.0401]
Take Rate	-5.320***	-6.140***	-6.103***	-6.843***
	[0.588]	[0.701]	[0.650]	[0.750]
Constant	27.75***	28.16***	27.90***	28.26***
	[0.132]	[0.139]	[0.142]	[0.154]
Implied But-For Take Rate	16.2%	16.6%	15.7%	16.2%
But-For Take Rate SE	[0.009]	[0.007]	[0.008]	[0.007]
Observations	284	284	212	212
R-squared	0.993	0.993	0.991	0.991
Third Parties Included	All	All	Large	Large

Source: Brattle analysis of worldwide monthly exchange data. See Event Study workpaper.

Notes: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

[248] The regression results in Figure 16 include month and exchange fixed effects in the estimation that are excluded from the figure for presentation purposes.

[A]: The dependent variable is the logarithm of worldwide monthly exchange impressions. The sample period is October 2018 through September 2021. Month and exchange fixed effects are included in the regression estimation but left out of the figure for presentation purposes. The monthly take rate for each group is calculated as the total net revenue divided by the total gross revenue for the included impressions in that month. Calculations performed across all in-market geographies, including unknown and missing geographies. UPR was first implemented by Google on September 25, 2019. I therefore consider October to 2019 to be the first "treated" month. See, GOOG-DOJ-AT-00292252, at -253. The dataset includes worldwide open web display impressions and outstream video ads. All Third Parties include Index Exchange, Magnite/Rubicon, OpenX, Pubmatic, Sovrn, Xandr, and YieldMo. Large Third Parties include Index Exchange, Magnite/Rubicon, OpenX, Pubmatic, and Xandr.

[B]: Data in this specification includes all exchanges.

[C]: Data in this specification includes all exchanges. The IV specification uses the sums of one month lagged take rates and CPMS from other exchanges.

[D]: Data in this specification includes only AdX and Large third parties.

[E]: Data in this specification includes only AdX and Large third parties. The IV specification uses the sums of one month lagged take rates and CPMS from other exchanges.

231. Across all four models, I observe that Google's share increases relative to other exchanges in the fourth quarter of 2019, when UPR was first adopted. For the OLS model using all data from all exchanges reported in column [B], my estimate of α is 0.192. This implies that my model finds that AdX's share of worldwide open web display impressions increased by 20.8 percent, relative to the change at other exchanges, following the introduction of UPR.[249] The estimate of β in the OLS model is -5.320. The ratio of these two estimates is 3.61 percent, and as described in Section IV.A.2, this implies a but-for take of 16.2 percent.[250]

232. Column [C] in Figure 16 reports estimates from the IV model, using data from all exchanges. The only difference between the IV and OLS models is that, for the IV model, I use the lagged sums of take rates and CPMs at other exchanges to instrument for the take rate of a focal exchange.[251] The IV and OLS results are very similar. In fact, I perform a standard statistical test that compares the IV and OLS estimates, and that test fails to reject the hypothesis that the OLS

---

[249] $21.2\% = (e^{0.192} - 1) \cdot 100$. Some of Google's internal estimates of UPR's effects indicate a lower percentage change in impressions, but those estimates use a different baseline and are not directly comparable to the coefficient estimates from this regression. *See* Figure 35.

[250] 16.2% = 19.8% - 3.6%.

[251] Appendix E reports a full set of diagnostic tests for these instruments.

estimates in column [B] are unbiased. The but-for take rate implied by the IV estimates is 16.6 percent.

233. The rightmost columns in Figure 17 present a set of OLS and IV results using data from only the "large" exchanges. For this sample, my estimates of α are somewhat larger than for the full sample that includes the two smaller exchanges (Sovrn and Yieldmo). For the large firm sample, my estimates of the implied but-for take rate are 15.7 percent based on the OLS model, and 16.2 percent based on the IV model.

234. The results in Figure 17 are robust to various changes in underlying assumptions. For example, Figure 27 in Appendix E shows estimates for the same IV and OLS models, with six variations in timing of the sample period and length of the lags in the instrumental variables. Although these alternative specifications do not have as strong IV diagnostics as those in Figure 16, they imply similar but-for take rates in the range of 15.0 to 17.3 percent.

235. In Figure 26 in Appendix E I report estimates of the same models in Figure 17 using data for only US impressions. Restricting my analysis to US impressions moderately decreases my estimated but-for take rates for each of my four regression specifications.

The event study approach does not account for how other ad exchanges would respond to a lower AdX take rate in the but-for world. In Section IV.A.2, I explained how both economic theory and Google's internal analysis suggest that takes rates could be substantially reduced in a counterfactual competitive equilibrium.[252] Thus, in my view, Figure 15 provides a reliable estimate of the upper-bound for the actual but-for take rate that can be used to calculate a conservative estimate of the damages incurred by the FAAs.

236. The but-for take rates calculated above are conservative for the reasons explained above. And even Google's own employees have discussed lower but-for take rates of 10%, 5%, or even lower for Google's exchange.[253]

---

[252] See the discussion at paragraphs 154 to 157 above.

[253] GOOG-TEX-00106259, at -260–61 (11/04/2017) (Payam Shodjai proposing a 5% AdX rev share for Authorized Buyer demand and undifferentiated DV360 demand, or DV360 demand without proprietary Google data and targeting); GOOG-DOJ-32034896, at -896 (06/20/2018) (Aparna Pappu proposing that for Google's

1		**Estimate total overcharge.**
2		**Estimate the proportion of the total overcharge paid by advertisers.**
	2a	Estimate the price elasticity of AdX advertiser demand for AdX impressions.
	2b	Estimate the price elasticity of supply for impressions sold to AdX advertisers.
	2c	Combine estimates from steps 2a and 2b using the model of tax incidence to calculate the share of the total overcharge incurred by advertisers.
3		**Combine the total overcharge from step 1 and the advertiser share from step 2c to calculate total percentage overcharge paid by FAAs.**

Source: Figure 10.

254. From Figure 29, I calculate a stack-wide take rate for FAA impressions sold on AdX through DV360. That is, I calculate the stack-wide take rate as the total net revenue that Google collects on both DV360 and AdX for FAA impressions, divided by the gross revenue per impression generated by those impressions. This stack-wide take rate is equal to 24.6 percent.[260]

255. Figure 21 below shows my estimates for AdX advertisers' share of the total overcharge due to Google's exclusionary conduct. Specifically, I combine my estimates of the elasticity of demand and supply on AdX (see Figure 17 and Figure 19, respectively) with AdX's stack-wide take rate to calculate the advertiser's share of the total overcharge.

FIGURE 21: ESTIMATED ADVERTISER SHARE OF OVERCHARGE

Simulated Price Increase	Demand Elasticity	Supply Elasticity	As-Is Take Rate	Direct Advertiser Overcharge Share	Take Rate Semi-Elasticity of Impression Price
[A]	[B]	[C]	[D]	[E]	[F]
2.50%	-2.81	0.47	24.6%	14.5%	19.2%
5.00%	-2.15	0.47	24.6%	18.0%	23.8%
6.18%	**-1.94**	**0.47**	**24.6%**	**19.3%**	**25.6%**
7.50%	-1.78	0.46	24.6%	20.5%	27.2%
10.00%	-1.57	0.45	24.6%	22.2%	29.4%

Source: Brattle analysis of GAM log-level data. See Overcharge workpaper.

Notes:

[B]: See Figure 17.

[C]: See Figure 19.

[260] *See* Figure 29.

[D]: See Figure 29.

[E]: $\frac{[C]}{[C]-[B]}$. This formula is derived in Section IV.B.2.

[F]: $\frac{1}{1-[D]} \cdot [E]$. This formula is derived in Section IV. B. 2.

256. My estimates for the share of the AdX overcharge that is paid by advertisers ranges from 19.2 to 29.4 percent. This implies that between 19.2 and 29.4 percent of the overcharge is reflected in higher prices paid by advertisers, and the other 70.6 to 80.8 percent is paid by publishers. In the final step of my calculation, I use estimates based on a simulated price increase of 6.18 percent, which imply that AdX advertisers incur 25.6 percent of the total overcharge.

V.C. Percentage Overcharge for Google Advertisers

257. In this section, I perform step 3 of my overcharge calculation. Specifically, I estimate the change in the AdX take rate advertisers would pay for impressions purchased through AdX between the as-is and but-for worlds. I do this by multiplying advertisers' estimated share of the total overcharge amount from Figure 21 by the percentage change in AdX's take rate implied by the but-for AdX take rates I estimated in Section V.A. The results of these calculations are shown in Figure 22 below.

1		**Estimate total overcharge.**
2		**Estimate the proportion of the total overcharge paid by advertisers.**
	2a	Estimate the price elasticity of AdX advertiser demand for AdX impressions.
	2b	Estimate the price elasticity of supply for impressions sold to AdX advertisers.
	2c	Combine estimates from steps 2a and 2b using the model of tax incidence to calculate the share of the total overcharge incurred by advertisers.
3		**Combine the total overcharge from step 1 and the advertiser share from step 2c to calculate total percentage overcharge paid by FAAs.**

Source: Figure 10.

FIGURE 22: TOTAL OVERCHARGE AND ADVERTISER OVERCHARGE, WORLDWIDE IMPRESSIONS

But-For Take Rate Analysis			But-For Take Rate	Percentage Change in Take Rate
Approach	Included Exchanges	OLS or IV (Event Study Only)		
[A]	[B]	[C]	[D]	[E]
Comparables	All Exchanges		16.2%	14.3%
	Large Exchanges		15.6%	16.8%
Event Study	All Exchanges	OLS	16.2%	14.5%
		IV	16.6%	12.9%
	Large Exchanges	OLS	15.7%	16.5%
		IV	16.2%	14.5%

Source: Brattle analysis of GAM log-level data, monthly exchange-level panel, and FAA non-FAA Comparison workpaper. See Overcharge workpaper

Notes:

[A]: Indicates whether the but-for take rate is derived from a comparables or event study analysis.

[B]: Indicates the set of exchange data from which the but-for take rate was calculated.

[C]: Indicates whether the event study regression model is estimated using OLS or IV.

[D]: But-for take rate associated with the analysis. See Figure 17 and Figure 19

[E]: Percentage change in stack-wide take rate, using an as-is AdX and stack-wide take rate of 19.8% and 24.6%, respectively. $\frac{19.8\%-[D]}{24.6\%}$.

258. My estimates for the total percentage change in stack-wide take rate associated with Google's conduct, shown in column [E] of Figure 22, ranges from 14.3 percent to 16.8 percent. In other words, the as-is stack-wide take rate is between 14.3 and 16.8 percent higher than it would be in the but-for world that I described in Section III.B. This is a measure of the overall damages incurred by both advertisers and publishers that use AdX.

259. Appendix D includes a recreation of Figure 22 for only US impressions.

VI. Additional Harm

260. My estimates of the overcharges on AdX during the damages period are conservative relative to the total harms incurred by FAAs due to the conduct at issue in this case because my model does not incorporate other types of harm caused by Google's conduct and incurred by FAAs. Though

Appendix C: Data Cleaning

C.1 Overview of Datasets

271. I relied on several datasets to perform the analyses in the present report. The dataset that was used in each analysis was determined by the question that the analysis seeks to address. For some analyses, I rely on one particular dataset that had been produced in this matter. In these cases, the datasets had to be restructured in a way that was conductive to performing the analysis in question. This is a standard procedure in empirical economics, and is typically referred to as the "data cleaning" or "data preparation" stage of an analysis.

272. For other analyses, there was no one dataset that could be used in isolation to perform the analysis in question. For example, in order to analyze the ad exchange market as a whole, data from several firms that operate ad exchanges were combined into one dataset which could then be analyzed. In these cases, the data cleaning required to perform my analysis resulted in a dataset incorporating data produced from multiple parties.

273. In the remainder of this subsection, I provide an overview of the datasets that were used to perform the analysis contained in this report. Then, in the subsequent subsections, I describe my data cleaning procedure in detail.

274. The analysis in this report uses three datasets, which I refer to as the aggregate exchange-level panel dataset, the June 2023 GAM Log-Level Bid Sample dataset, and the RFP60 DV360 submission dataset. I describe these datasets in the remainder of this appendix.

C.2 Aggregate Exchange-Level Panel

275. Some analysis discussed in this report uses a dataset I refer to as the "aggregate exchange-level panel" dataset. This dataset summarizes key data on the firms that operate ad exchanges selling display advertising impressions, though it also contains information on ad impressions that do not fit this description. I have reviewed the Lee Expert Report, and have constructed this dataset to include the ad impressions that are sold in the ad exchange relevant market as I understand

Professor Lee to have defined it.[270] The firms' ad exchanges that are covered in this dataset are: AdX, DCN, Equativ, Index Exchange, Magnite, OpenX, Pubmatic, Sharethrough, Sovrn, Xandr, Yahoo, Yieldmo, and Zedo. I understand that the ad exchanges Fyber, IronSource, Unity, and Vungle have also produced data in this matter that I have not incorporated into this dataset because I understand these exchanges to sell impressions that are not in the relevant product market as defined by Professor Lee. Moreover, I exclude AdSense from my analyses as it is a Google product in the same market defined by Professor Lee and likely does not serve as a reasonable comparable as a result. Where available, this dataset contains information on net revenue, gross revenue, and impressions sold, and these data are disaggregated by advertisement type, geography and month.

276. For analysis of worldwide exchange data, I exclude exchanges who only produced data associated with US impressions. AdX data identifies impressions sold through Open Bidding separately from those sold through open auctions. I remove AdX observations associated with Open Bidding from calculations using this dataset. All calculations using the aggregate exchange-level panel include only those observations associated with display and outstream video impressions sold via open auctions, private auctions, or header bidding. In instances where a characteristic of an impressions used to determine whether it falls within the relevant market is unknown or missing, I assume that characteristic falls within the relevant market.

277. For each exchange, I establish a set of market definition variables that are used to filter to the relevant market in subsequent analyses. The following are the variables constructed and the possible values they can take:

- User geography (TBG_geography): US, ROW, missing, unknown
- Advertiser geography (TBG_adv_geo): US, ROW, missing, unknown
- Publisher geography (TBG_pub_geo): US, ROW, exclude, missing, unknown
- Transaction type (TBG_auction): deal, open, other, private, header bidding, exchange bidding, missing, unknown

[270] *See* Lee Report, Section IV.D.